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GROUNDWATER POLLUTION FEATURES OF FEDERAL AND STATE STATUTES AND REGULATIONS

General Electric Company

PREPARED FOR
Environmental Protection Agency

July 1973

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Laws and regulations related to groundwater pollution vary widely as to objectives, scope, coverage, detail, and effectiveness. State water laws tend to deal primarily with protection of surface-water resources. Only 13 States were found to have water laws dealing in detail with measures to protect groundwater against pollution. However, numerous other laws and regulations affect groundwater pollution.

A more extensive review of policies, rules, regulations, and procedures, with an evaluation of their effectiveness in controlling groundwater pollution, is recommended. (EPA)

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GROUNDWATER POLLUTION FEATURES OF FEDERAL AND STATE STATUTES AND REGULATIONS

by

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TEMPO
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CONTENTS

Section		Page
	ABSTRACT	
	ACKNOWLEDGEMENTS	
I	CONCLUSIONS	1
II	RECOMMENDATIONS	2
III	INTRODUCTION	3
	LEGISLATIVE AND CONTRACTUAL REQUIREMENTS	3
	APPROACH	4
IV	EXISTING STATE STATUTES AND REGULATIONS	7
	STATE WATER AND WATER POLLUTION STATUTES	7
	Definition of Waters of the State	7
	Jurisdiction	9
	Statutes Concerning Groundwater Pollution	9
	Sumps	12
	Oil and Gas Wells	12
	Waste-disposal Wells	12
	Mine Wastes	14
	Oil Spills	15
	Classification of Groundwaters	16
	STATE WATER-WELL REGULATIONS	16
	Principal Features	16

CONTENTS (Cont'd.)

Section		Page
	Well Drillers Licensing	17
	Well Construction	17
	Abandoned Wells	23
	Recharge Wells	24
	Administrative Complexities	24
	Examples of Modern Water-Well Regulations	24
	SOLID-WASTE ADMINISTRATIVE REGULATIONS	29
	Permits	32
	Design Criteria	32
	Leachate Collection and Treatment	37
	Monitor Wells	38
V	ORDINANCES AND ADMINISTRATIVE REGULATIONS OF SELECTED LOCAL AGENCIES	39
	SELECTED COUNTIES	39
	In California	39
	In Florida	43
	In New York	46
	SELECTED COMMISSIONS	49
	Great Lakes-Upper Mississippi Board of State Engineers	49
	Recommended Standards for Sewage Works (Ten-State Standards - 1971)	49

CONTENTS (Cont'd.)

Section		Page
	Recommended Standards for Water Works (Ten-State Standards-1972)	51
	The Railroad Commission of Texas	52
	Susquehanna River Basin Compact (1967)	53
	Delaware River Basin Commission	53
VI	STATUTES AND REGULATIONS OF THE FEDERAL GOVERNMENT	54
	FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 (Public Law 92-500)	54
	GROUNDWATER POLLUTION AT FEDERAL FACILITIES	59
	PROTECTION AGAINST RADIATION	60
	PROTECTION AGAINST PESTICIDES	61
	Federal Insecticide, Fungicide and Rodenticide Act-1972	61
	EPA Regulations for Enforcement of Pesticide Act of 1972	61
	GUIDELINES FOR WASTE WATER TREATMENT FACILITIES	62
	GUIDELINES FOR SOLID-WASTE DISPOSAL	63
	Solid-Waste Disposal Act, 1970	63
	Recommended Standards for Sanitary Landfill Design, Construction, and Operation - EPA 1971	63
	Sanitary Landfill Design and Operation - EPA 1972	64
	Proposed EPA Guidelines for Land Disposal of Solid Wastes	64
VII	MISCELLANEOUS CODES AND STANDARDS	66

CONTENTS (Cont'd.)

Section		Page
	NATIONAL STANDARD PLUMBING CODE	66
	AMERICAN WATER WORKS ASSOCIATION	67
	MODEL WATER CODE	68
VIII	NEW DEVELOPMENTS	69
	SELECTED STATES	69
	Alaska	69
	California	69
	Delaware	70
	Hawaii	70
	Indiana	70
	Iowa	71
	Maryland	71
	Type I Aquifers	72
	Type II Aquifers	72
	Type III Aquifers	73
	Massachusetts	75
	Minnesota	76
	Mississippi	76
	Missouri	76
	New Hampshire	76

CONTENTS (Cont'd.)

Section		Page
	Tennessee	77
	Texas	79
	Utah	80
	Vermont	80
	Virginia	80
	Wisconsin	81
	REGULATORY COMMISSIONS	81
	Ohio River Valley Water Sanitation Commission (ORSANCO)	81
	Delaware River Basin Commission	82
	FEDERAL GOVERNMENT	83
	Pending Legislation	83
	National Water Commission	83
IX	REFERENCES	86

FIGURES

1. Map showing the five geologic regulatory areas of Maryland 25
2. Well construction requirements in Illinois, for creviced formations 30
3. Well construction requirements in Illinois, for creviced formations where overburden is less than 30 feet thick 31
4. Map showing groundwater quality zones in Santa Clara County, California 42

CONTENTS (Cont'd.)

FIGURES (Cont'd.)

		Page
5.	Typical general sealing features for destroyed wells in Santa Clary County, California.	44
6.	Typical sealing features for destroyed gravel-packed wells in Zone 2 in Santa Clara County, California	45
7.	Logarithmic chart showing aquifer types for groundwater quality standards in Maryland.	74

TABLES

1.	Selected Provisions of State Water and Water-Pollution Laws - 1972	10
2.	Summary of Selected Provisions of Water-Well Regulations by State, 1972.	18
3.	Minimum Recommended Distance Between Wells and Source of Contamination or Pollution	20
4.	Minimum Permissible Distances Between Wells and Sources of Contamination in Arkansas	21
5.	Minimum Permissible Distances from Points of Possible Contamination to Groundwater Supplies in Alaska	22
6.	Minimum Drill Hole Size and Grouting Requirements in Maryland	26
7.	Minimum Casing and Well Construction Requirements in Maryland	27
8.	Summary of Sanitary Landfill Design Criteria for States Having Solid Waste Regulation, November 1972.	33
9.	Summary of Ordinances in California Counties Pertaining to Water Wells as of 1967	40
10.	Maximum Allowable Values for Certain Materials in, or Characteristics of, Waste Waters Entering Dade County, Florida, Sewerage Systems	47

ABSTRACT

This report summarizes regulations and requirements of major public agencies with respect to groundwater pollution. A selective review was made of existing and pending legislation and regulations of Federal, State, and county governments and their agencies. Material was obtained both from central compilations and by direct contact with public agencies. State water laws, water-pollution laws, water-well regulations, and solid-waste regulations were examined; also, Federal laws dealing with pollution at Federal facilities, protection against radiation and pesticides, and guidelines for waste-water treatment and solid-waste disposal facilities.

Laws and regulations related to groundwater pollution vary widely as to objectives, scope, coverage, detail, and effectiveness. State water laws tend to deal primarily with protection of surface-water resources. Only 13 States were found to have water laws dealing in detail with measures to protect groundwater against pollution. However, numerous other laws and regulations affect groundwater pollution.

A more extensive review of policies, rules, regulations, and procedures, with an evaluation of their effectiveness in controlling groundwater pollution, is recommended.

This report was submitted in fulfillment of Task 2A, Contract Number 68-01-0759, by General Electric-TEMPO under the sponsorship of the Environmental Protection Agency. Work was completed as of July 1973.

ACKNOWLEDGEMENTS

The cooperation of many public officials who provided information on existing and pending legislation is acknowledged with sincere thanks.

Mr. Harvey O. Banks, consulting engineer, of Belmont, California, reviewed the material and made valuable suggestions.

Mr. Charles F. Meyer of General Electric-TEMPO was the manager of the project under which this report was prepared. Mr. Donald B. Gilmore of the Office of Research and Development, U. S. Environmental Protection Agency, was the Program Element Director.

SECTION I

CONCLUSIONS

1. The statutes and regulations of Federal and State agencies vary widely as to objective, scope, and detail in providing for control of groundwater pollution. State water and water pollution statutes tend to deal primarily with surface water; only 13 States were found to have water statutes dealing specifically and extensively with groundwater quality. However, in a broad sense, all of the States appear to have legislation under which may be undertaken measures found necessary for the protection of groundwater quality.

2. The results obtained from a review of Federal and State water, water pollution, and solid waste disposal statutes and regulations, with a sampling of the many other statutes and regulations that relate to groundwater pollution, provide background and perspective for developing a concept and methodology for monitoring groundwater quality.

3. Within the limited framework of the survey that was undertaken, it is not possible to evaluate the effectiveness of a given State's efforts in regulating groundwater pollution, or to compare in a meaningful way the effectiveness of various State programs. The effectiveness of a State's program depends upon enforcement of its statutes and regulations. This brings into question the procedures for enforcing legislative mandates, and the organization, funding, and personnel of enforcement agencies. Further, the role of local governments cannot be ignored because they may impose standards more stringent than those required by State laws, to meet the needs of local conditions. In addition, groundwater pollution can be remedied by private parties through injunctive procedures under State statutes, local ordinances, or the common law.

SECTION II

RECOMMENDATIONS

An extension of the study reported here is recommended in order to provide the Environmental Protection Agency with an improved basis for developing cooperative groundwater-protection programs and for evaluating State implementation plans.

The recommended study would address the question of effectiveness: To what extent do existing State and Federal laws exercise control over groundwater pollution? To search out all relevant statutes, examine the policies, regulations, and decisions of all of the agencies involved, and evaluate the effectiveness of the countless implementing organizations and procedures, would be a very large task. A less extensive but in-depth study could be conducted in a few States - perhaps five to ten - selected to provide examples of the problems encountered, standards imposed, and organizational structures and enforcement procedures. As a starting point, the States to be studied might be selected through a review of implementation plans submitted to the EPA by the States.

SECTION III

INTRODUCTION

LEGISLATIVE AND CONTRACTUAL REQUIREMENTS

In October 1972, Congress enacted Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972. The objective of PL 92-500 is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Act recognizes "the primary responsibilities and rights of the States to prevent, reduce, and eliminate pollution," while further stating the policy of the Congress to support and aid research and to provide Federal technical services and financial aid to State and interstate agencies in connection with the prevention, reduction, and elimination of pollution. The Administrator of the Environmental Protection Agency is to cooperate with other Federal agencies, State water pollution control agencies, interstate agencies, and the municipalities and industries involved, in preparing or developing comprehensive programs for preventing, reducing, or eliminating the pollution of ground waters and improving their sanitary condition. (Sections 101 and 102)

The contract under which this report was prepared covers the development of a concept and methodology for monitoring groundwater quality, in support of developing and enforcing groundwater quality standards. With regard to monitoring, Section 104 of the Act directs the Administrator of the Environmental Protection Agency to establish national programs for the prevention, reduction, and elimination of pollution, and, as part of such programs, in cooperation with the States, their political subdivisions, and other Federal agencies, to estab-

lish, equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of groundwaters. For this purpose, the Administrator is authorized to make grants to State water pollution control agencies, interstate agencies, and others.

In order to relate the development of a concept and methodology for monitoring groundwater quality to the actions of Federal and State agencies in establishing and enforcing water quality standards, the contract between the Environmental Protection Agency and General Electric-TEMPO includes a task which reads as follows: "Task 2A: Summarize regulations and requirements of major public agencies with respect to groundwater pollution."

General Electric-TEMPO engaged Geraghty & Miller, Inc. to prepare this report in partial fulfillment of the requirements of Task 2A.

APPROACH

A survey was made of Federal and State legislation that directly relates to groundwater quality. A selective review was made of local ordinances and of regulations of administrative agencies. The legislative material which was the principal focus is that body of law normally identified as water laws, water pollution laws, water well regulations, and solid waste disposal regulations. Not covered is the law as developed by the courts, or decisions involving the legislation of interest. Consequently, any reference in this report to a "law" or "laws" excludes this body of law. Also excluded is the legal action open to private parties who might remedy groundwater pollution by seeking an injunction against an offender, by means of a claim under a State statute, local ordinance, or the common law.

It is to be emphasized that the purpose of Task 2A is limited. This purpose is to provide perspective and the proper orientation for the balance of the work to be accomplished under the contract. Thus, coverage of statutes identified as water laws and water pollution laws is reasonably complete and up to date, as is the coverage of water-well codes. However, there are many other statutes and countless administrative regulations that influence groundwater quality, and only a sampling of these was undertaken. The latter body of law includes, for example, legislation and regulations covering oil and gas wells, pipelines, sewers, injection wells, and interstate basins.

The survey was based principally upon materials obtained from central compilations such as those of the Bureau of National Affairs covering Federal and State water laws* and solid waste laws, and from the material available in the files of the Water Information Center, Inc., a subsidiary of Geraghty & Miller, Inc. Section X lists the source materials and references. In addition, a number of direct contacts were made with public agencies to review pending legislation regarding groundwater pollution and to obtain the current thinking and concerns of water-resources officials regarding the need for additional protective legislation and regulations.

In the references that were examined, many ambiguities were noted in the use of terms such as law, act, statute, regulation, standard, and code. Phrases such as water-well regulations and water-well standards are used as found in the references, with no implication that these terms have different meanings. "Statute" is used to mean a legislative enactment of a Federal or State legislative body. "Ordinance" refers to county or local governmental enact-

*The Summary-Digests of Federal and State Water Laws by the National Water Commission became available after completion of this survey.

ments. "Regulation" ordinarily means an administrative action rather than an enactment of a legislative body. However, regulations may be adopted by legislative bodies, as may standards and codes; hence, these terms are to be regarded as being quite ambiguous.

SECTION IV

EXISTING STATE STATUTES AND REGULATIONS

STATE WATER AND WATER POLLUTION STATUTES

Most of these statutes refer only in general terms to water, water pollution, and groundwater. The emphasis in the statutes is largely organizational; that is, they are designed to set up departments or agencies that in turn are charged with preparing and enforcing regulations for management and control.

State water statutes deal primarily with the protection of surface-water resources, and references to groundwater or groundwater pollution are sparse. The principal reference to groundwater is commonly a mention of the term in the definition of the "waters of the State".

Definition of Waters of the State

The following basic definition of the terms "Waters of the State" or "State Waters", or a similar one, is found in most state statutes:

> "Waters of the State" - all streams, lakes, ponds, marshes, water courses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof (Minnesota). 1)

An interesting aspect of the definition is the fact that 14 states make certain exceptions to

1) Minnesota Statutes Annotated §115.01 Subd. 9 (1971)

the all-inclusiveness of this term. In Georgia and Missouri, the definition excludes those waters "entirely confined and retained completely upon the property of a single individual, partnership, or corporation". [2] Mississippi excludes "lakes, ponds, or other surface waters that are wholly landlocked and privately owned". [3] In Oregon, Ohio, North Dakota, New York, New Mexico, and Tennessee, the definition excludes "those private waters which do not combine or effect a junction with natural surface or underground waters". Privately-owned ponds are excluded from the definition in Indiana, [4] and in West Virginia, [5] farm ponds, industrial settling basins and ponds, and water treatment facilities are excluded. In Florida, waters owned entirely by one person other than the State are included only with regard to possible discharge on other property or into water bodies. [6] In Utah, bodies of water confined to and retained within the limits of private property, and which do not develop into or constitute a nuisance, or a health hazard, or a menace to fish and wildlife, are excluded. [7] In Montana, irrigation waters consumed within the irrigation system and not returned to any other State waters are excluded from the definition. [8]

Similar exceptions not specified in the "Waters of the State" definition but mentioned elsewhere in the water statutes are as follows: private waters not discharging into or polluting any other State waters in Arizona; [9] gas and oil wells, injection wells, retention ponds, and irrigation systems in Colorado; [10] and copper and iron mining operations in Michigan. [11]

2) Georgia Code Annotated, Ch. 17-5 §3(d)(1972); Missouri State Statutes § 204.010(7)(1967)
3) Mississippi Code of 1942 § 7106-112, Subd. 1(f)(1966)
4) Indiana Statutes, Chap. 214 §16 (1967)
5) West Virginia Code § 20-5A-2(e) (1969)
6) Florida Statutes § 403.031 (3) (1972)
7) Utah Code Annotated § 73-14-2(f)
8) Montana Revised Code § 69-4802 (9) (1971)
9) Arizona Statutes § 36-1857(B) (2) (1967)
10) Colorado Statutes § 66-28-9(2)(b) (1970)
11) Michigan Act 245, § 12 (1973)

Jurisdiction

Another feature of some State statutes is that jurisdiction over certain operations that might pollute groundwater lies with agencies other than the principal water-pollution control agencies. In California, for example, geothermal wells come under the jurisdiction of the Department of Conservation, and the disposal of brines from production of oil comes under State and Regional Water Quality Control Boards. In Texas, drilling and operation of oil and gas wells come under the authority of the Texas Railroad Commission. The same agency also administers oil and gas waste wells according to the Texas Injection Well Act.

Statutes Concerning Groundwater Pollution

Table 1 lists some of the more common provisions relating to groundwater pollution that were found in State water and water-pollution statutes. Omitting oil-spill provisions which are of a general nature, it appears that the water statutes of only 13 States have any kind of provisions dealing in some detail with protection of the groundwater. Most of these provisions deal with prevention of pollution of groundwater by requiring proper well construction, sealing off of polluted zones, or control of mine discharges. In most of these 13 States, groundwater is extensively used for public supply, industrial operations, or irrigation (for example, California, Texas, Florida, and New York). References to water wells in the State statutes mostly apply to requirements for permits, construction details, completion reports, logging, and sampling. Of interest is the fact that California includes special wells known as cathodic protection wells, which are installed for the purpose of protecting metallic equipment in contact with the ground.

Table 1. SELECTED PROVISIONS OF STATE WATER AND WATER-POLLUTION LAWS - 1972

State	Water wells			Oil and gas wells		Waste wells		Other activities		
	Drillers licensed	Construction standards	Sealing abandoned wells	Construction standards	Sealing abandoned wells	Construction standards	Sealing abandoned wells	Oil-spill provision applicable	Groundwater classification issued	Mine discharge regulated
Alaska								x		
Arizona						x				
California		x	x			x	x	x		
Colorado						x				
Connecticut								x		
Delaware								x		
Florida						x [a]	x	x		
Illinois			x [b]				x [b]			
Indiana			x [c]		x [c]		x [c]			x
Kansas				x	x	x	x			
Louisiana								x		
Maine								x		
Maryland	x	x	x							
Massachusetts								x		
Michigan										x
Minnesota								x		
Missouri						Prohibited				
New Jersey								x		
New York									x	
Oklahoma			x			Prohibited				

Table 1 (continued). SELECTED PROVISIONS OF STATE WATER AND WATER-POLLUTION LAWS - 1972

State	Water wells			Oil and gas wells		Waste wells		Other activities		
	Drillers licensed	Construction standards	Sealing abandoned wells	Construction standards	Sealing abandoned wells	Construction standards	Sealing abandoned wells	Oil-spill provision applicable	Groundwater classification issued	Mine discharge regulated
Oregon								x		
Pennsylvania		x [d]		x [d]		x		x		
Texas						x [e]				
Washington								x		
West Virginia						x				
Wisconsin		x [f]								

[a] Secondary waste treatment prior to discharge into injection well mandatory; at least 90% (organic removal) treatment to be provided.
[b] Pollution Control Board authorized to promulgate standards for filling or sealing of abandoned water wells and holes for disposal of drainage.
[c] State Stream Pollution Control Board has power to require sealing of mines, oil & gas wells, brine wells or any other subterranean strata.
[d] Regulations primarily affect well drilling operations and prevention of pollution from discharge of mud, oil, and salt water on land surface.
[e] Design report required for earthen lagoons, and storage pits to determine whether ground-water contamination will occur.
[f] Permit required for water wells if rate of withdrawal is in excess of 100,000 gallons per day.

Sumps ——

Pennsylvania requires a sump or other receptacle to be provided at each water well and oil-well drilling operation to receive all drill cuttings, sand bailings, water having a turbidity in excess of 1,000 ppm, or other polluting wastes resulting from the well-drilling operations. Upon completion of the well, the sump must be covered over or otherwise protected, or the contents of the receptacle shall be disposed of in such a way that they will not be washed into the waters of the State.

Oil and Gas Wells ——

References to construction, drilling, and operation or plugging of oil or gas wells are found in the water statutes of only three States, Indiana, Kansas, and Pennsylvania. However, these same activities may be covered by other statutes, for example, the Railroad Commission Acts in Texas and the California Public Resources Code. Of interest are detailed provisions of the Kansas statutes regarding the length of casing required to protect fresh water-bearing strata during seismic and core-hole drilling and in the drilling of oil and gas test wells. Prior to drilling, approval for the amount of casing necessary to protect all "usable" water is required. By "usable" water is meant water containing 5,000 ppm chlorides or less. Prior to abandoning such wells, every effort must be made to "protect any usable underground or surface water from infiltration or addition of any detrimental substances".

Waste-disposal wells ——

Waste-disposal wells are referred to in the water statutes of 12 States. Three of these, Ari-

zona, Missouri, and Oklahoma, prohibit construction or use of any waste-disposal well. Arizona prohibits discharge to "any well either abandoned or constructed for that purpose, that is carried to such a depth as to penetrate water-bearing strata". No waste may be discharged into "any crevice, sink-hole, or other opening, either natural or artificial, or in a rock formation which will or may permit the pollution or contamination of groundwater". Missouri allows return of oil-field wastes to "such oil-producing formation as from which they were obtained". Oklahoma prohibits discharge into wells, pits, or holes, or into water-bearing strata from which a domestic or public supply is drawn or may be drawn. California prohibits waste discharge into aquifers suitable for a source of public or domestic water supply but allows waste wells under certain conditions. California also requires the filing of a technical report describing methods and controls to be used for closing a waste well prior to abandonment. Colorodo prohibits discharge of waste underground unless the authorities have established "beyond a reasonable doubt that there will be no pollution".

In Florida, a permit is required for drilling and use of a waste well or drainage well. Among the requirements for an application for a waste-disposal well are an inventory of all water-supply wells, together with construction details, within a one-mile radius of the disposal well. Bacteriological examinations of groundwater from all water-supply wells within the one-mile radius that are drilled to the approximate depth of the proposed drainage well may also be required except in cases of wells receiving condenser cooling water or where the receiving aquifer contains 1,500 mg/l or more of chlorides.

Kansas requires approval of plans and specifications prior to installation of a waste-disposal

well. The State authorities must determine that the proposed method will not result in loss of waste of gas or petroleum resources and that the water resources of the State are protected from "preventable" pollution. Kansas is the only State that specifies injection pressure and establishes maximum allowable injection pressures for underground disposal of salt water, mineralized brine, and oil or oil-well waste.

Pennsylvania allows underground waste disposal but only where geologic conditions are such that it is improbable that the disposal will be prejudicial to the public interest. However, the approval is conditional and does not relieve the applicant of responsibility for any pollution of the waters of the Commonwealth which may occur, in which case such disposal shall be stopped.

The State water statutes of Texas approve of injection of salt water or waste connected with the production of oil or gas as long as the injection well is properly licensed and administered by the Texas Railroad Commision. West Virginia has no specific provisions regarding construction or use of waste wells but requires that all persons engaged in such business file pertinent information on the injection or waste well with the State Water Resources Division. This required information may include data on the "kind, characteristics, amount, and rate of flow of such discharge, deposit, escape, release or disposition".

Mine Wastes ——

The water statutes of three States contain a reference to operation of mines and disposal of mine wastes including acid mine drainage. Indiana requires that storage, transportation, and

mining of coal shall be done so as to create minimal acid mine drainage. No gob (coal waste) may be used in the construction of public or private roadways in Indiana, which will cause acid mine drainage to the waters of the State. The Michigan water statutes do not apply to discharge from underground iron or copper-mining operations, subject to a determination by the water-resources commission that the pollution is minimal. Pennsylvania prohibits discharge of acid mine drainage. Applications for new mines or re-opening of mines must include a report on plans for proposed drainage and disposal of industrial wastes and acid mine drainage. Disposal of acid-forming refuse from strip mines is specifically covered, according to the type of coal (anthracite or bituminous) and degree of water saturation.

For example, in cases of bituminous strip mines where the affected area will be impregnated with water above the highest elevation of the refuse disposal area, the acid-forming materials must be separated from the rest of the spoil and deposited along the bottom of the pit. All exposed refuse must be covered with clean fill daily if necessary to prevent pollution, but at least at intervals not to exceed one week. The top surface of this cover must be graded so that surface water will run off rather than soak into the backfill to reach the acid-forming refuse.

Oil Spills ——

The water statutes of 12 States contain sections pertaining to oil spills. By "oil spills" is meant the discharge or loss of oil to waters of the State. "Oil" is generally defined as petroleum, petroleum products, sludge-oil refuse, and any other oil-like substance of animal, mineral, or vegetable origin. Other States, for example, Connecticut, include chemical

liquids or products from vessels in this definition. Although the oil-spill provisions are primarily meant for protection of surface waters in coastal zones, the wording of the statutes and the all-inclusive definition of "waters of the State" make these statutes applicable in the case of groundwater pollution stemming from oil spills on the land surface.

Classification of Groundwaters ——

The water statutes of only one State, New York, contain a system of classification and standards of groundwaters. The purpose of this system is "to prevent pollution of groundwaters and to protect the groundwaters for use as a potable water". Three classes of water are given:

1. Class GA; fresh groundwater best used as sources of potable water supply;
2. Class GSA; saline groundwater of possible use for conversion to fresh potable water;
3. Class SSB; saline water having a chloride content greater than 1,000 mg/l or a total dissolved-solids content greater than 2,000 mg/l.

Discharge of raw or treated sewage, industrial waste, treated effluents, toxic waste, and other polluted fluids that might impair the specified use is prohibited. Chemical characteristics to which the water must conform are given and distinctions are made between discharge of wastes in the unsaturated zone and the saturated zone.

STATE WATER-WELL REGULATIONS

Principal Features

Using data in the files of Geraghty & Miller, Inc. and Water Information Center, Inc., together with recent information received from several States, a summary of requirements re-

garding water wells was prepared. State water-well regulations were reviewed to ascertain mandatory protective measures regarding the construction of public-supply wells, domestic wells, irrigation wells, industrial wells, licensing of drillers, plugging and sealing of abandoned wells, and sealing off of polluted zones. (Information on regulations of three States was not available for review.) The principal features of these regulations are summarized in Table 2.

Well Drillers Licensing

Well drillers are required to be licensed in most of the States covered in the review. Several States require licensing of well drillers in designated areas only. For example, in New Mexico, only licensed well drillers may operate within the boundaries of declared underground water basins, which comprised roughly a third of the State's area in June 1972 (30th Biennial report of the State Engineer of New Mexico, 1970-72, p. 4). In New York, licensing is required on Long Island but not in the rest of the State.

Well Construction

Regulation of construction of water wells varies from State to State. It appears that public supply wells are regulated in all States but control of drilling of water wells for domestic, irrigation and industrial use takes place in only one third of the States. The twelve States on Table 2 listed as having "No Regulations" do control the installation of public supply wells by issuing guidelines or following recommended standards prepared by interstate agencies such as the Ten-States Standards (see Section V). The State of Iowa, for example, has no

Table 2. SUMMARY OF SELECTED PROVISIONS OF WATER-WELL REGULATIONS BY STATE, 1972

(X, regulation applies; ----, information not available)

State	Drillers Licensed	Well Construction Regulations				Plugging and Sealing Regulations		Recharge Wells Regulated
		Public Water Supply	Domestic	Irrigation	Industrial	Abandoned Wells	Contaminated Zones	
Alabama	----	----	----	----	----	----	----	----
Alaska		X		X	X			X
Arizona		X				X	X	X
Arkansas	X	X	X	X	X	X	X	X
California	X	X	X	X	X	X	X	X
Colorado	X	X	X	X	X	X	X	X
Connecticut	X	X	X	X	X			
Delaware	X	X	X	X	X	X	X	----
Florida	X	X	X	X	X	X	X	X
Georgia		X				X		X
Hawaii				No Regulations				
Idaho	X			No Regulations				
Illinois	X	X	X			X	X	X
Indiana	X	X				X	X	X
Iowa				No Regulations				
Kansas	X	X	----	----	----	X	X	----
Kentucky	----	----	----	----	----	----	----	----
Louisana	----	----	----	X		X	X	X
Maine				No Regulations				
Maryland	X	X	X	X		X	X	
Massachusetts				No Regulations				
Michigan	X	X	X	X	X	X		X
Minnesota	X	----	----	----	----	----	----	----
Mississippi	X	----	----	----	----	----	----	----
Missouri		X				X		
Montana	X	X				X	X	
Nebraska		X		X	X	X		
Nevada	X	X	X	X	X	----	----	X
New Hampshire				No Regulations				
New Jersey	X	X	X	X	X	X	X	X
New Mexico	X [a]	X		X [a]	X [a]	X [a]		
New York	X [a]			No Regulations				X [a]
North Carolina	X	X	X	X	X	X	X	X
North Dakota	X	X	X	X	X	X	X	
Ohio	----	----	----	----	----	----	----	----
Oklahoma	X [b]	X	X	X	X	X	X	X
Oregon	X	X	X	X	X	X	X	
Pennsylvania	X	X				X		
Rhode Island	X			No Regulations				
South Carolina				No Regulations				
South Dakota	X	X		X	X	X		X
Tennessee	X	X	----	----		X	X	
Texas	X	X		X	X	X	X	X
Utah	X	X	X	X	X	X	X	
Vermont	X			No Regulations				
Virginia				No Regulations				
Washington				No Regulations				
West Virginia		X		----	----	X	X	
Wisconsin	X		X			X		
Wyoming		X	X	X		X	X	

[a] Applies to designated areas only

[b] As of July 1, 1973

regulations pertaining to the drilling of water wells for domestic or irrigation supplies, other than a permit system which requires application for any project which intends to withdraw more than 5,000 gallons per day. This permit system is under the jurisdiction of the Iowa Natural Resources Council and controls only rates of withdrawal. The Iowa Department of Environmental Quality, however, is responsible for reviewing plans and specifications for all new construction for public water supplies. The Ten States Standards and the AWWA Standards are applied in reviewing and approving these projects.

Provisions relating to public water-supply wells in at least 31 States contain requirements such as site protection against flooding, minimum distance from source of pollution (sewer, cesspool), and minimum length of casing and grouting to prevent entrance of surface waters to the well and aquifer. However, the specifications for minimal distances, lengths of castings, and grouting vary from State to State. Most States adhere to minimum recommended distances given by the U. S. Public Health Service Manual of Individual Water Supply Systems, 1962 (see Table 3). Other States have deviated from these standards and require somewhat different minimal distances (see Table 4, Arkansas and Table 5, Alaska). In addition, several States, including Arkansas and California, point to the need for evaluation of the type of geologic formation present, depth to an aquifer, and the effect of pumping on groundwater movement. Alaskan regulations require increased minimum distances with higher pumping rates. Arkansas requires increased lateral distances where the upper formations are more pervious. Most of the regulations regarding minimum distances from sources of pollution appear to be somewhat arbitrary and are generally not based on the theory of groundwater flow.

Table 3. MINIMUM RECOMMENDED DISTANCE BETWEEN WELLS AND SOURCE OF CONTAMINATION OR POLLUTION
(Source: U. S. Public Health Service, 1962)

Sources of contamination or pollution	Distance, feet
Septic tank	50
Sewer lines	
With permanent watertight joints	10
Other	50
Sewage disposal field	100
Seepage pit	100
Drywell	50
Cesspool	150

Table 4. MINIMUM PERMISSIBLE DISTANCES BETWEEN WELLS AND SOURCES OF CONTAMINATION IN ARKANSAS
(Source: Arkansas Water Well Construction Code, 1972)

Sources of contamination	Minimum lateral distances for clay and loam soils,[a] feet
Cesspools	100
Leaching pit	100
Pit privy	100
Subsurface seepage tile	100
Manure piles	100
Septic tank	100
Sewers (non-cast iron)	50
Sewers (cast iron with watertight leaded or mechanical joints)	50
Footing drains (no connection to a sewer or a sump handling sewage)	10
Pump-house floor drain (cast iron with watertight joints and having free fall discharge to ground surface)	2

[a] When the upper formations are more pervious, the lateral distances shall be increased (e.g., double the distance for highly pervious gravel formations).

Table 5. MINIMUM PERMISSIBLE DISTANCES FROM POINTS OF POSSIBLE CONTAMINATION TO GROUND-WATER SUPPLIES IN ALASKA
(Source: Alaska Dept. of Environmental Conservation, 1973)

Class	Pumping rate (gpm)	Any contamination	Minimum distances, feet		
			Sewers,[a] septic tanks	Seepage pits or beds, subsurface-disposal fields	Cesspools
Private	-	10	50	100	150
Semi-public	-				
A	0 - 50	40	80	120	150
B	50 - 100	80	120	150	200
C	Over 100	100	200	200	200
Public	Any	100	200	200	200

[a] All sewers, except cast-iron pipe with leaded and caulked joints.

Very few States require protective land ownership around a public water-supply facility. In those States that have regulations for domestic, irrigation, and industrial wells, the construction provisions are the same as for public-supply wells, but are less detailed, with shorter distances allowed from sources of pollution, shorter casings and grouting, and other differences. More often, in the case of domestic wells, the regulations are recommended and not mandatory. Some States only regulate wells in designated areas or wells that withdraw more than a certain quantity of water, for example, New Jersey and New York, and several States, such as Maryland and Illinois, vary their regulations to fit local geologic and hydrogeologic conditions.

Abandoned Wells

Plugging and sealing of abandoned wells is required by the majority of the States. However, sealing off of polluted formations or saline aquifers is referred to in the regulations of only 22 States. Again individual regulations among the States regarding filling and sealing of wells range from general to quite specific. Some States refer to detailed procedures for abandoning wells contained in the AWWA Standard for Deep Wells, as in North Dakota. Other States, for example, California and New Jersey, have issued their own explicit requirements. California requires that wells penetrating several aquifers shall be sealed so as to prevent interchange of waters between aquifers that would result in a significant deterioration of the water quality in one or more aquifers or would result in a loss of artesian pressure. Variable requirements for sealing of wells penetrating unconsolidated material, fractured rock, and non-fractured rock are also given.

Recharge Wells

Recharge wells normally fall under the general classification of water wells, and are therefore automatically covered by regulations. However, air conditioning wells that return heated water or wells that are used for the disposal of runoff from roof tops have been classified in some States, such as California, as waste-disposal wells subject to water-quality control statutes.

Administrative Complexities

In some States, responsibilities for regulation of water-well construction are divided among several agencies. In Vermont, for example, the Department of Health and the Department of Water Resources control construction and operation of municipal water systems, whereas the Department of Health and the Public Service Board have jurisdiction over private and cooperative water systems (Comprehensive Long Range Water-Supply Program for the State of Vermont 1972, pp. 29-30).

Examples of Modern Water-Well Regulations

The Maryland well-construction standards are quite explicit. For purposes of regulation, Maryland is divided into five geologic areas (see Figure 1). The hydrogeologic conditions of each area are given together with the requirements for minimum depth of oversize drill holes for grouting, minimum casing diameters, and minimum casing depths (Tables 6 and 7). The well construction standards vary from area to area.

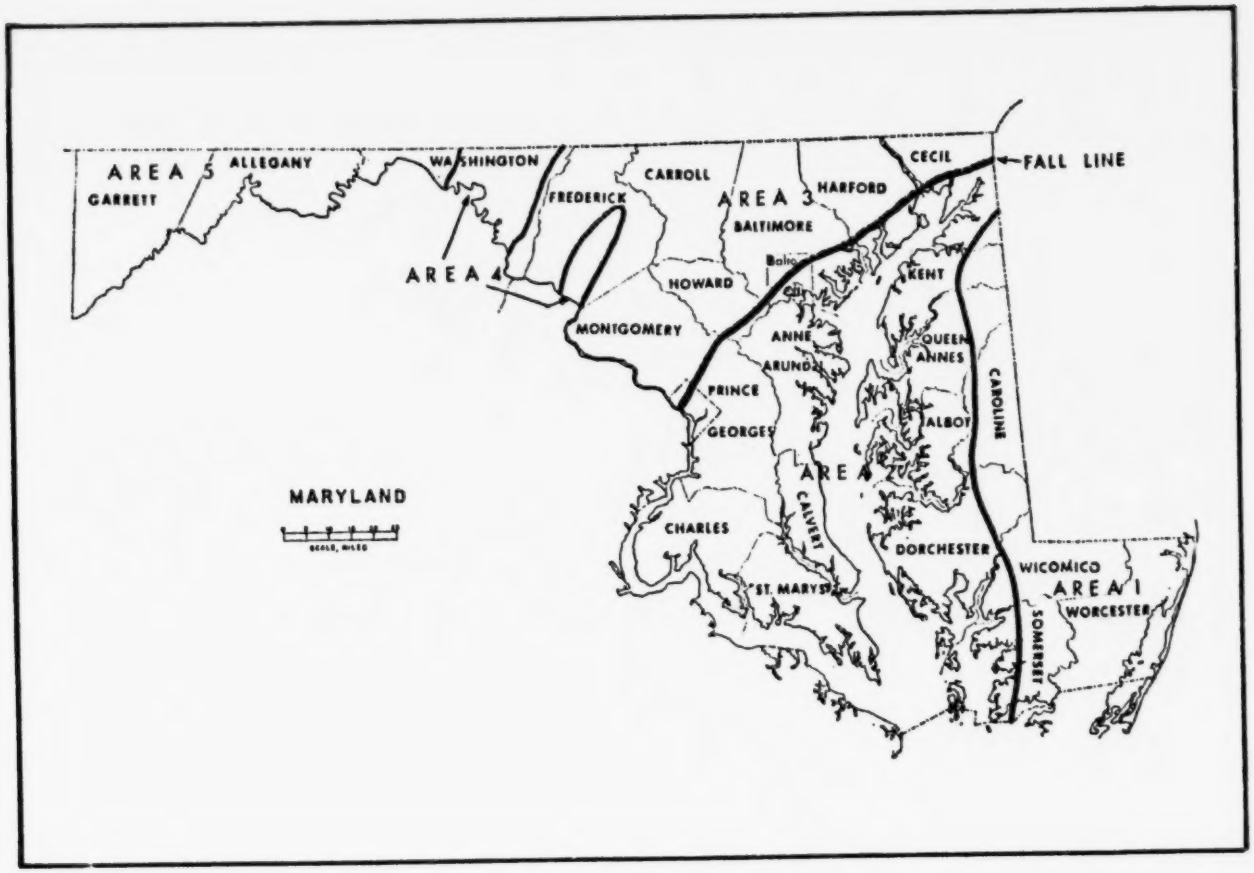

Figure 1 - Map showing the five geologic regulatory areas of Maryland.
(Source: Maryland Water Resources Adm., 1972)

Table 6. MINIMUM DRILL HOLE SIZE AND GROUTING REQUIREMENTS IN MARYLAND
(Source: Maryland Water Resources Adm., 1972)

Groundwater Province or Area	Hydrologic Conditions	Water-Bearing Material	Overburden	Oversize Drill Hole For Grout	
				Diameter	Depth
Coastal Plain Areas 1 & 2	Water-table	(1) Sand and/or gravel	None; aquifer material extends to surface	Casing size plus 4"	20' minimum to surface
		(2) Semi-consolidated "rock" or shell beds	None; aquifer material extends to surface	Casing size plus 4"	20' minimum to surface
Coastal Plain Areas 1 & 2	Artesian	(1) Sand and/or gravel	Confining layers of clay, sandy clay, silt or similar materials	Casing size plus 4"	The minimum depth shall be to the base of the confining layer immediately above the aquifer used but not less than 20' below land surface.
		(2) Semi-consolidated "rock" or shell beds	Confining layers of clay, sandy clay, silt or similar materials	Casing size plus 4"	The minimum depth shall be to the base of the confining layer immediately above the aquifer used but not less than 20' below land surface.
Piedmont and Appalachian Areas 3, 4 & 5	Water-table and semi-water table	(3) Creviced granite, gneiss, schist, phyllite, quartzite metagabbro, diorite and similar rocks	Weathered rock, true soil, and stream alluvium	Casing size plus 3" or as approved by the Department	The minimum depth shall be to the bottom of the casing.
		(4) Limestone, dolomite, and shaly limestone	Weathered rock, true soil, and stream alluvium	Casing size plus 3" or as approved by the Department	The minimum depth shall be to the bottom of the casing.
		(5) Creviced sandstone, shale and silstone	Weathered rock, true soil, and stream alluvium	Casing size plus 3" or as approved by the Department	The minimum depth shall be to the bottom of the casing.

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Table 7. MINIMUM CASING AND WELL CONSTRUCTION REQUIREMENTS IN MARYLAND
(Source: Maryland Water Resources Adm., 1972)

Ground-water Province or Area	Hydrologic Conditions	Well Diameter		Minimum Casing Depth	Construction Conditions and Miscellaneous Requirements
		Casing	Screen		
Coastal Plain Areas 1 & 2	Water-table	2" minimum 3" to 5" preferred	1¼" minimum	20' minimum	After casing is in its permanent position the annular space between casing and sediments shall be filled with a sodium-base bentonitic clay slurry or cement grout where required. An adequate well screen shall be provided where necessary to permit pumping sand-free water from the well. Shallow water-table wells not recommended in localities closer than 300 feet from tidewater (brackish water bodies).
Coastal Plain Area 1	Artesian	2" minimum when static level less than 125' below ground surface. 4" or more preferred	1¼" minimum diameter; non-corrosive material recommended	To extend to top of water bearing material. Casing may be telescoped; however, the 2" min. size casing shall extend to a minimum depth of two thirds the well depth or 150' whichever is less.	The annular space created by the oversize drill hole shall be grouted with neat cement or a sodium-base bentonitic clay slurry. An adequate well screen shall be provided where necessary to permit pumping sand-free water from the well. When the static level is greater than 125' below ground surface and/or the pumping level is greater than 150' below ground surface, a minimum casing diameter of 4" is required. This 4" casing must extend at least 20 feet below the pumping level.

Table 7 (continued). MINIMUM CASING AND WELL CONSTRUCTION REQUIREMENTS IN MARYLAND

Groundwater Province or Area	Hydrologic Conditions	Well Diameter		Minimum Casing Depth	Construction Conditions and Miscellaneous Requirements
		Casing	Screen		
Coastal Plain Area 2	Artesian	Same as Area 1	Screen not required where "rock" has sufficient strength to remain open	Same as Area 1	Same as Area 1; caution should be used to avoid clogging of "rock" voids by cement grout.
Piedmont and Appalachian Areas 3, 4, & 5	Water-table and semi-water table	(3) 4" minimum 6" or larger recommended	Not normally used	10' minimum	Casing shall be seated into rock at base of weathered zone. Cement grout shall extend from the bottom of casing to the surface or base of the pitless adapter.
		(4) 6" minimum	Not normally used	20' minimum	Tubular channels and crevices in limestone may not hold grout; packers must frequently be used to grout above large water-filled channels and crevices. Limestone wells are highly susceptible to pollution, and grouting may not be successful in preventing this condition.
		(5) 4" minimum 6" or larger recommended	Not normally used	10' minimum	Same as Area 3

The Illinois well-construction standards have separate sections for wells in unconsolidated formations and wells in consolidated formations. Diagrams are provided showing construction under variable situations of unstable overburden (loose sand and gravel), stable overburden (clay, glacial till), gravel wall construction (with and without outer casing), creviced formations (earth mantle over 30 feet thick and less than 30 feet thick) and an aquifer occurring below creviced formations (see Figures 2 and 3).

SOLID-WASTE ADMINISTRATIVE REGULATIONS

Not all States have specific statutes dealing with disposal of solid wastes, although most States have some administrative regulations regarding disposal of refuse. In those States without specific solid-waste regulations, some broad regulations regarding waste disposal are commonly included in water-pollution or environmental-protection statutes. Practically all comprehensive regulations pertaining to solid-waste disposal have been promulgated since 1968.

The possibility of groundwater pollution, and the consequent need for geologic studies, hydrologic studies, and proper design of solid-waste disposal sites, is recognized in the regulations in only 22 States. In the 28 remaining States, 8 make no mention at all of the possibility of groundwater or surface-water pollution, 18 refer to it only in general terms, and Alaska and Hawaii have no specific regulations.

Some examples of generalized statements on potential pollution stemming from solid waste disposal are as follows:

Missouri: "Location of the disposal area shall be such as to not endanger potable water supplies."

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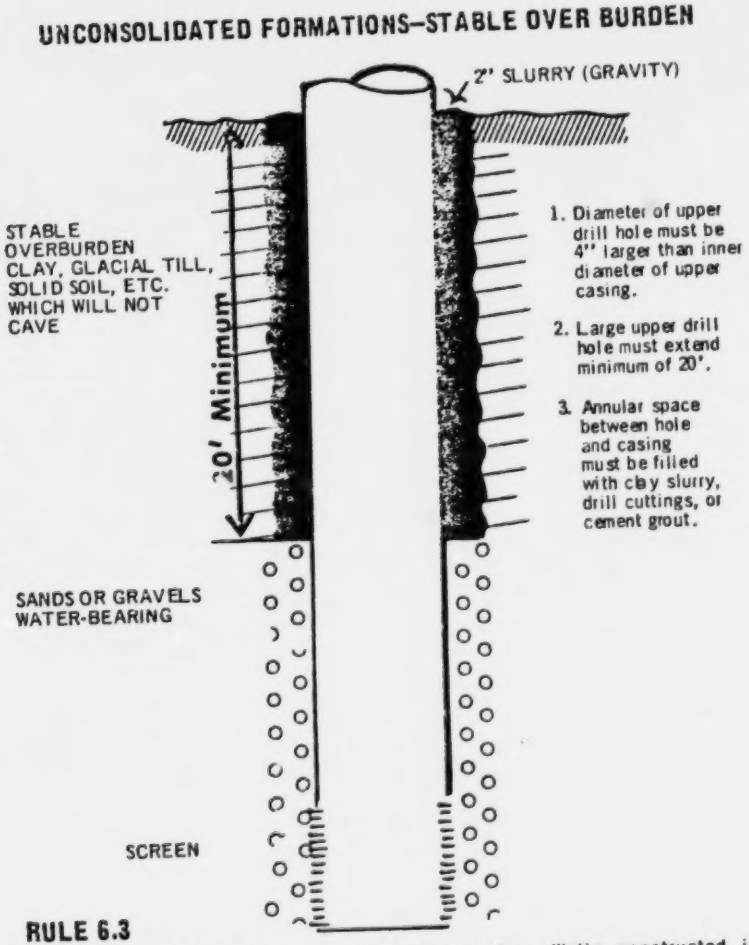
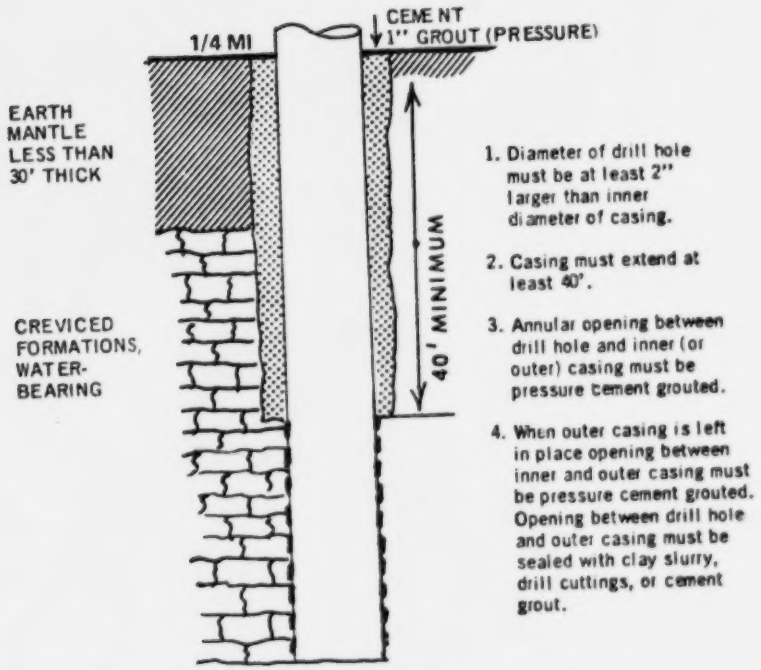

UNCONSOLIDATED FORMATIONS–STABLE OVER BURDEN
2" SLURRY (GRAVITY)
STABLE OVERBURDEN CLAY, GLACIAL TILL, SOLID SOIL, ETC. WHICH WILL NOT CAVE
20' Minimum
1. Diameter of upper drill hole must be 4" larger than inner diameter of upper casing.
2. Large upper drill hole must extend minimum of 20'.
3. Annular space between hole and casing must be filled with clay slurry, drill cuttings, or cement grout.
SANDS OR GRAVELS WATER-BEARING
SCREEN

RULE 6.3

Unconsolidated Formations with Stable Overburden. Wells constructed in geological formations such as sand and gravel which lie below clay, glacial till or other relatively stable soil shall have a casing installed governed by the pumping level. For pumping levels greater than 20 feet the casing shall extend 5 feet below the pumping level. For pumping levels 20 feet or less the casing shall extend 10 feet below the pumping level. Under no conditions shall there be less than 20 feet of permanent casing installed. Since the stable overburden cannot be expected to form a continuous contact seal with the casing, sealing of the annular opening between the casing and the drill hole must be affected. This can be accomplished by constructing an upper drill hole having a diameter four inches greater than the inner diameter of the casing to be installed and extending to a depth of at least 20 feet. The upper drill hole shall be sealed with drill cuttings, clay slurry or cement grout after the casing is in place.

Figure 2 - Well construction requirements in Illinois, for creviced formations, (Source: Illinois Dept. of Public Health, 1970)

CREVICED FORMATIONS
Earth Mantle Less Than 30 Feet Thick


CEMENT
1" GROUT (PRESSURE)
1/4 MI
EARTH MANTLE LESS THAN 30' THICK
CREVICED FORMATIONS, WATER-BEARING
40' MINIMUM
1. Diameter of drill hole must be at least 2" larger than inner diameter of casing.
2. Casing must extend at least 40'.
3. Annular opening between drill hole and inner (or outer) casing must be pressure cement grouted.
4. When outer casing is left in place opening between inner and outer casing must be pressure cement grouted. Opening between drill hole and outer casing must be sealed with clay slurry, drill cuttings, or cement grout.

RULE 7.1.2

Where the earth mantle is less than 30 feet in thickness for a radius of one-quarter mile around the well, the well casing shall extend to a depth of at least 40 feet below ground level. The diameter of the drill hole shall be a minimum of two inches greater than the inner diameter of the casing. The annular space shall be pressure cement grouted as provided for in Section 9.7. When an outer casing is left in place the annular space between the casings shall be pressure cement grouted and the annular opening around the outer casing shall be sealed with drill cuttings, clay slurry or cement grout.

Figure 3 - Well construction requirements in Illinois, for creviced formations where overburden is less than 30 feet thick.
(Source: Illinois Dept. of Public Health, 1971)

Arizona: "The landfill shall be located so that seepage will not create a health hazard, nuisance, or cause pollution of any water course or water-bearing strata."

Permits

In general, the various State regulations apply to dumping of refuse or waste materials at any site on public or private property, and call for the issuance of permits in all cases. However, 8 States (California, Colorado, Iowa, Kansas, Montana, North Carolina, Tennessee, and Washington) allow dumping on private property without a permit, unless a public health hazard is created. A statement to this effect is usually referred to as the "Landowner s rights preserved" clause. Typical examples of such a clause are as follows:

Montana: "This act shall not be construed to prohibit any person from disposing of his own garbage, rubbish or refuse upon his own land as long as such disposal does not create a nuisance."

Washington: "Nothing herein shall prohibit a person from dumping or depositing solid waste resulting from his own activities onto or under the surface of ground owned or leased by him when such action does not violate statutes or ordinances, or create a nuisance."

Design Criteria

A comparison of design requirements for solid waste-disposal sites by the 22 States that have such provisions is given in Table 8. As may be seen, all 22 States require a study of soil con-

Table 8. SUMMARY OF SANITARY LANDFILL DESIGN CRITERIA FOR STATES HAVING SOLID WASTE REGULATION, NOVEMBER 1972
(x, item required)

State	Geologic study	Soils study	Test borings	Water table mapping	Water well inventory (radius)	Buffer zone between refuse and water table (minimum thickness, ft)	Leachate to be contained and/or treated	Underlying rock barrier to be sealed or impervious barrier to be placed	Monitoring wells
California [a]	x	x	x	x		x	x	x	x [b]
Colorado [a]	x	x	x	x	x				
Connecticut [a]	x	x	x	x	x (1,000 ft)	x (4 ft)			
Delaware	x	x	x	x	x (1 mile)	x (2 ft)			
Georgia [a]	x	x	x	x	x				
Idaho		x	x	x	x (500 ft)				x [b]
Illinois		x	x	x		x			
Indiana		x	x	x					x [b]
Kentucky	x	x	x	x		x			
Massachusetts	x	x	x	x	x	x (4 ft)			
Michigan	x	x	x	x				x [d]	
Minnesota	x	x	x	x	x [c]	x (10 ft)			
Mississippi	x	x	x	x	x	x (5 ft)	x [b]		
New Jersey	x	x	x	x					
New Mexico	x	x	x	x	x		x [b]		x [b]
Oregon	x	x	x	x	x		x [b]		x [e]
Pennsylvania	x	x	x	x	x (1/4 mile)	x (6 ft)			x
South Carolina	x	x	x	x	x		x		
Tennessee	x	x	x	x	x (1 mile)				
Texas	x	x	x	x	x [f]	x		x	x [b]
Vermont	x	x	x	x					
Wisconsin	x	x	x	x		x (10 ft) [d]			

[a] Specific requirements not listed but implied in order to meet engineering report design criteria
[b] May be required
[c] Minimum distance from water well or public-water system, 1 mile
[d] In toxic and hazardous disposal areas
[e] A minimum of one ground-water quality monitoring well to be drilled in each dominant direction of ground-water movement
[f] Minimum distance from water well or public-water system, 500 feet

ditions through the use of test borings and mapping of the elevation of the water table. Nineteen of these 22 States require specific "geologic" studies in addition to a soil survey. Soil borings are usually specified as "to be taken to an adequate depth to determine soil conditions at the site". In some cases, however, specific depths such as 10 feet are stipulated for the borings. Idaho requires a minimum depth of 10 feet; Minnesota, South Carolina, Wisconsin, and Indiana require borings to at least 10 feet below the proposed excavation and the lowest elevation of the site. Pennsylvania requires borings drilled 5 feet into the groundwater or bedrock or 20 feet below the base of the proposed landfill. Texas requires test borings to a depth of no less than 20 feet below the lowest proposed excavation.

Practically all States that require submission of an engineering design report call for mapping of the water table below a proposed site. Commonly, it is stated that the highest water-table elevation has to be known in connection with a required buffer zone between the landfill and the water table.

Maps showing the locations of water wells in the vicinity of the proposed landfill site are required by 14 States. The radial distance to which this survey must be carried out varies from 500 feet in Idaho to 1 mile in Delaware and Tennessee. Pennsylvania requires submission of maps showing the location of public and private water supplies, wells, and springs within one quarter of a mile of the proposed site. Connecticut requires such data within a radius of 1,000 feet. Texas and Minnesota prohibit the location of a solid waste-disposal area within a distance of 500 feet and one mile, respectively, from a water well or public water system.

Eleven of the 22 States having specific regulations specify that a "buffer zone" or a "safe, vertical distance" be maintained between refuse and water table to insure that no contact occurs between refuse deposits and the water table. Seven of these States specify a minimal thickness of such a buffer zone, which ranges from 2 feet in Delaware to 10 feet in Minnesota and Wisconsin. California sets no minimum thickness of the buffer zone, but requires "geological conditions naturally capable of preventing hydraulic continuity between liquids and gases emanating from the waste in the site and usable surface or groundwaters". The State may also require man-made physical barriers to be placed to meet design criteria. Connecticut requires that "at least four feet of clean fill be maintained between refuse and high groundwater levels at the site and at least four feet between refuse and ledge rock". In the case of disposal of septic-tank pumpings in a trench, the same State requires a minimum of two feet of clean fill between the bottom of the trench and high groundwater level, to be increased to at least four feet of clean fill in areas where ledge rock is predominant. A definition of clean fill is not given.

Massachusetts similarly does not specify the type of buffer material but calls for a minimum distance of four feet of earth from the lowest point of refuse deposition to the maximum groundwater elevation during the highest groundwater period of the year. Minnesota specifies that disposal shall take place at least 10 feet above the groundwater level, or at least 10 feet above limestone, quartzite, or granite-type bedrock and sandstone. Also, it stipulates that toxic and hazardous disposal areas shall be "sealed" prior to disposal. The nature of such a seal is not further identified.

Mississippi's sanitary landfill regulations are interesting because they are the only ones of all the State regulations on this subject that explain the reasons for design criteria and that list environmental considerations. Buffer zones are discussed as follows:

> "Although the possible effect on groundwater is not completely understood at the present time, interaction between the two is to be avoided. Various organization have specified different distances to be maintained between the top level of groundwater and the bottom of the landfill. Generally, a minimum distance of 5 feet will make the leachate bacterially safe. For chemical safety, distances have yet to be published." And in a later paragraph regarding methods of operation: "Water pollution can be prevented by avoiding the groundwater table and providing proper surface drainage."

Pennsylvania has included the following regulations relating to low permeability barriers:

a) To assure that there is no risk of free flow to groundwater, sites with less than six feet of fine soil over limestone or other fissured rocks; or coarse sand and gravel shall be considered unsuitable.

b) A site with six or more feet of fine soil over limestone or other fissured rocks, or coarse sand and gravel, is classed in the range of limited suitability.

c) Depth to the seasonal high water table shall be greater than six feet from the bottom of the lowest refuse lift. The depth shall be increased by at least six feet for each additional lift depending on the character of the earth material.

Low-permeability soil barriers also are required in Texas to minimize the possibility of leach-

ate percolating into the groundwater. The following procedures are considered acceptable in the Texas regulations:

1. Placement of three feet of clay.
2. Placement and compaction of one foot of selected clayey material under optimum moisture conditions.
3. Placement of an impervious membrane of asphaltic, plastic, or other approved material.

The regulations of 28 States require daily compaction and a minimum thickness of earth cover over each daily layer of waste. After a dump is filled and prior to closing, a final slope has to be such that rainfall and runoff are diverted away from the fill area. The daily minimum earth cover to be applied is at least 6 inches (except for Vermont which requires a minimum cover of 4 inches), while the final cover seal is to be at least 2 feet.

Leachate Collection and Treatment

Only five of the 22 States specify that leachate originating from the waste material must be contained or treated. California requires that leachate and subsurface flow into the disposal area shall be contained within the site. Mississippi mentions possible leachate treatment. Pennsylvania requires leachate collection and treatment facilities for the prevention of groundwater pollution at substandard sites that lack a suitable natural soil barrier. Provisions for collection and treatment of leachate must accompany design reports in Oregon and South Carolina.

Monitor Wells

California, Illinois, Kentucky, Oregon, Pennsylvania, South Carolina, and Texas mention the possibility of requiring monitoring facilities, or more specifically, monitoring wells, to observe changes in the quality of groundwater at or near the site. However, only one state (Pennsylvania) has a mandatory requirement in this regard. This requirement states that a minimum of one monitoring well shall be drilled in each dominant direction of groundwater movement, with locations of wells to be approved in advance of drilling by the groundwater geologist of the Department of Environmental Resources.

SECTION V

ORDINANCES AND ADMINISTRATIVE REGULATIONS OF SELECTED LOCAL AGENCIES

SELECTED COUNTIES

In California

Regulation of construction, abandonment, and sealing of water wells in the counties of the State of California in 1967 was summarized in the California Water-Well Standards issued in 1968. At that time, 12 of California's 58 counties had ordinances regulating well construction, abandonment, or destruction. They ranged in scope from simple endorsements of the "Kathy Fiscus Law" (which requires the filling, covering, or fencing of excavations) to requirements covering construction features and materials. The content of these ordinances is summarized in Table 9. These ordinances are administered by the respective county health departments. In addition, several county health departments have standards which they apply to the construction of community water-supply wells in systems under their jurisdiction. Notable among these are San Bernardino and San Diego Counties.

The Counties of Alameda, Orange, Los Angeles, Santa Clara, Kern, and Santa Barbara were contacted early in 1973 regarding their administrative regulations pertaining to water supply, well-drilling, and solid waste. Alameda County has no such regulations. Los Angeles County has adopted the California Water-Well Standards. Santa Clara County is in the process of drafting proposed well-construction and well-sealing standards. Kern County adopted construction and sealing regulations in 1969 (Ordinance G-1225). The information received from Orange and Santa Barbara Counties was insufficient for comment.

Table 9. SUMMARY OF ORDINANCES IN CALIFORNIA COUNTIES PERTAINING TO WATER WELLS AS OF 1967
(Source: California Water-Well Standards, Bull. No. 74, 1968)

County	Ordinance No.	Permit or notice	Ordinance covers				
			Construction		Abandonment		
			Location	Construction features	Cover (temporary)	Destroy	Sealing requirement
Contra Costa	1189	P [a]	R	R	-	O	O
Fresno	389	-	-	-	O	O	-
	524 [b]	N	O	O	O	O	-
Los Angeles	7583 [c]	P [d]	O	O	-	O	O
Mendocino	333	P	R	R	-	-	-
Merced	275	-	-	-	O	O	-
Riverside	340A	P	-	-	-	-	-
Sacramento	508	P	O	O	-	-	O
San Francisco	659	P	-	-	-	R	-
San Luis Obispo	9-905	P	R	R	-	R	R
San Mateo	1100	P	O	O,R	O	-	O
Santa Clara	NS 1203.12 [e]	-	O	O	-	O	R
Tulare	385	-	-	-	O	O	-

[a] Symbols: P, Permit; N, Notice; R, Governed by regulations; O, Specific provisions in ordinance.
[b] Applicable to individual domestic wells only.
[c] Not all provisions apply to all wells.
[d] Permit for reconstructed or converted wells.
[e] Applies to individual domestic wells and community water-supply wells.

The Kern County Ordinance indicates that the well-construction standards are partly based on the California Water-Well Standards; references to these standards appear in the various sections of the Ordinance. Well drillers are to be licensed; well permits are required and standards for construction and sealing of wells are given together with minimum distances from potential sources of pollution.

A section on disposal wells has the following requirements:

1. The disposal water shall not cause the temperature of the adjacent groundwater to increase more than 8 degrees F.
2. The discharge shall not contain certain toxic materials or other substances which will alter the existing groundwater quality in the disposal area.
3. The discharge shall not cause a public nuisance.
4. A sampling tap shall be installed at the disposal-well site in such a manner that water, representative of the water entering the well may be withdrawn for laboratory analysis.

The Santa Clara County Flood Control Water District is in the process of drafting county-wide ordinances on well-construction and well-sealing standards. The tentative sealing standards are of interest because they are adjusted to suit local conditions of geology and water quality. The county has been divided into three groundwater quality zones (see Figure 4). Zone 1, with generally good quality groundwater, Zone 2 near San Francisco Bay where the shallow (0 to 150 feet) zone may be polluted or could become polluted by sea water, and Zone 3 (Evergreen area) where poor quality groundwater occurs below 300 feet with good quality water overlying this zone. Sealing procedures reflect these variable hydrogeologic conditions.

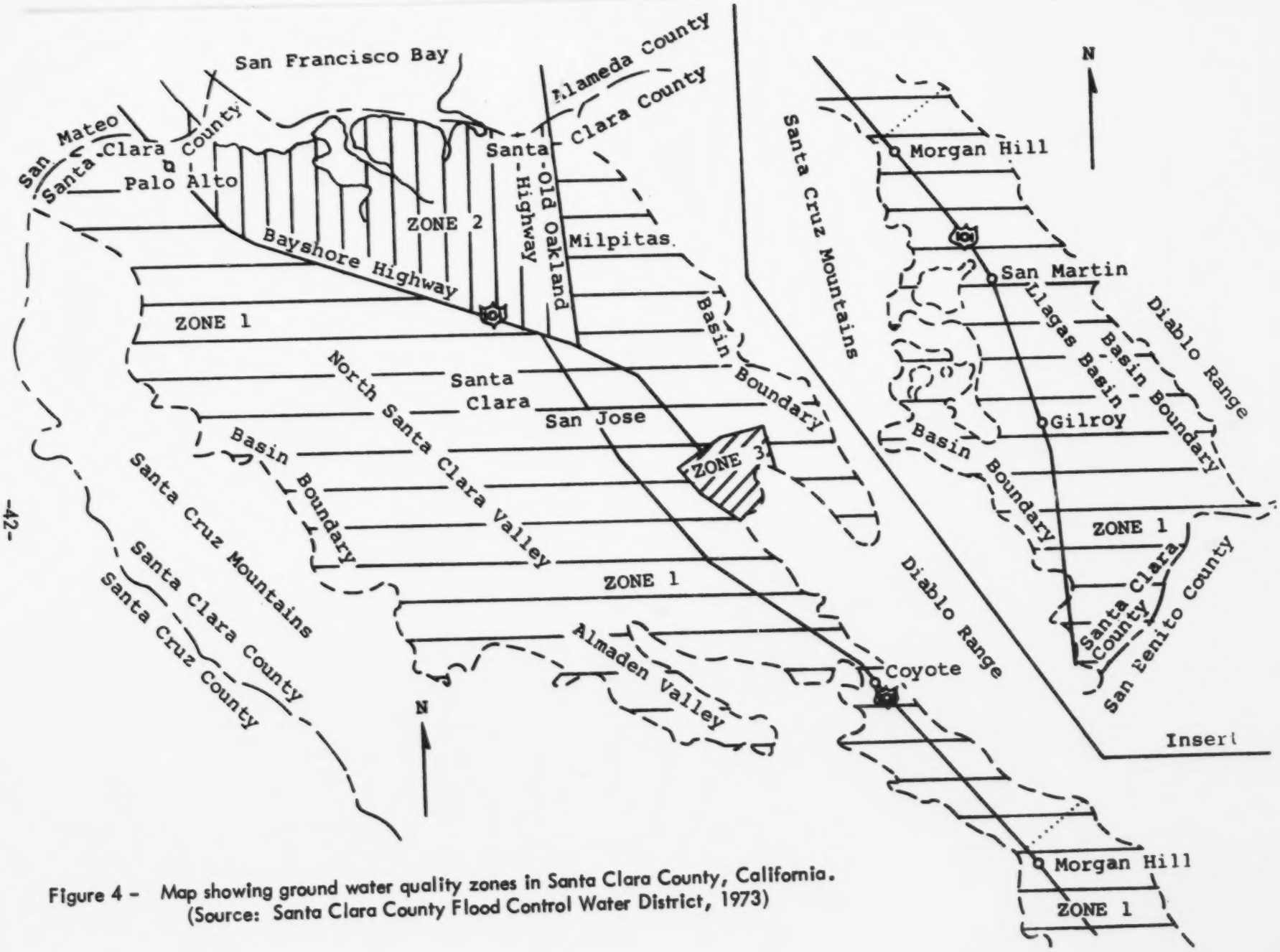


Figure 4 - Map showing ground water quality zones in Santa Clara County, California. (Source: Santa Clara County Flood Control Water District, 1973)

Figure 5 represents the required sealing procedure for a typical abandoned well. Figure 6 portrays recommended sealing procedures in Zone 2 (San Francisco Bay area). These sealing requirements are more specific than the general sealing requirements given in the State Water-Well Regulations.

In Florida

The Dade County Ordinance No. 72-76 of October 31, 1972, is of special interest because it contains several sections related to sampling and protection of the groundwater. Water-quality standards for Dade County are given and a prohibition is included against the discharge of sewage, industrial wastes, cooling water, solid wastes, or any other wastes into the surface water, tidal salt water estuaries, or groundwater in such quantities, and of such characteristics as may cause the receiving waters, after mixing with the waste streams, to be of poorer quality than the water-quality standards.

In cases of waste discharge into the ground, the regulations require that samples be taken from wells nearest to and encircling the point of entry of a waste stream into the groundwater table. Test wells may be required to be installed and maintained if existing sampling points are found to be inadequate in the judgment of the Pollution Control Officer.

Deep disposal wells, defined as any conduit designed to, or operated so as to discharge waste water or sewage of any nature, or any deleterious substances, into the ground at depths greater than 2,000 feet, have to meet listed requirements regarding BOD, floatable and suspended solids, and coliform bacteria. Discharge of wastes pumped from septic tanks into aquifers or on the ground surface is prohibited.

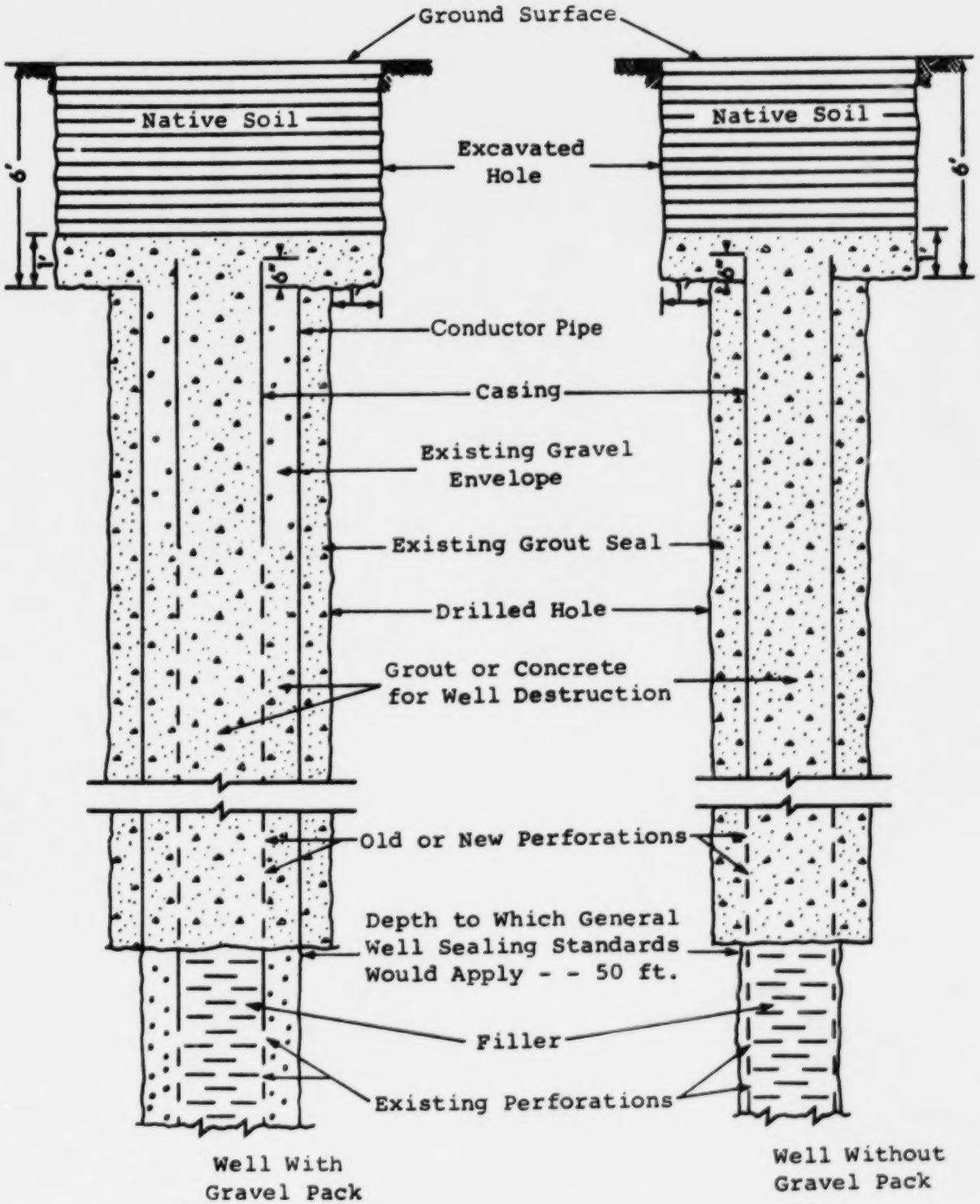


Figure 5 - Typical general sealing features for destroyed wells in Santa Clara County, California.
(Source: Santa Clara County Flood Control Water District, 1973)

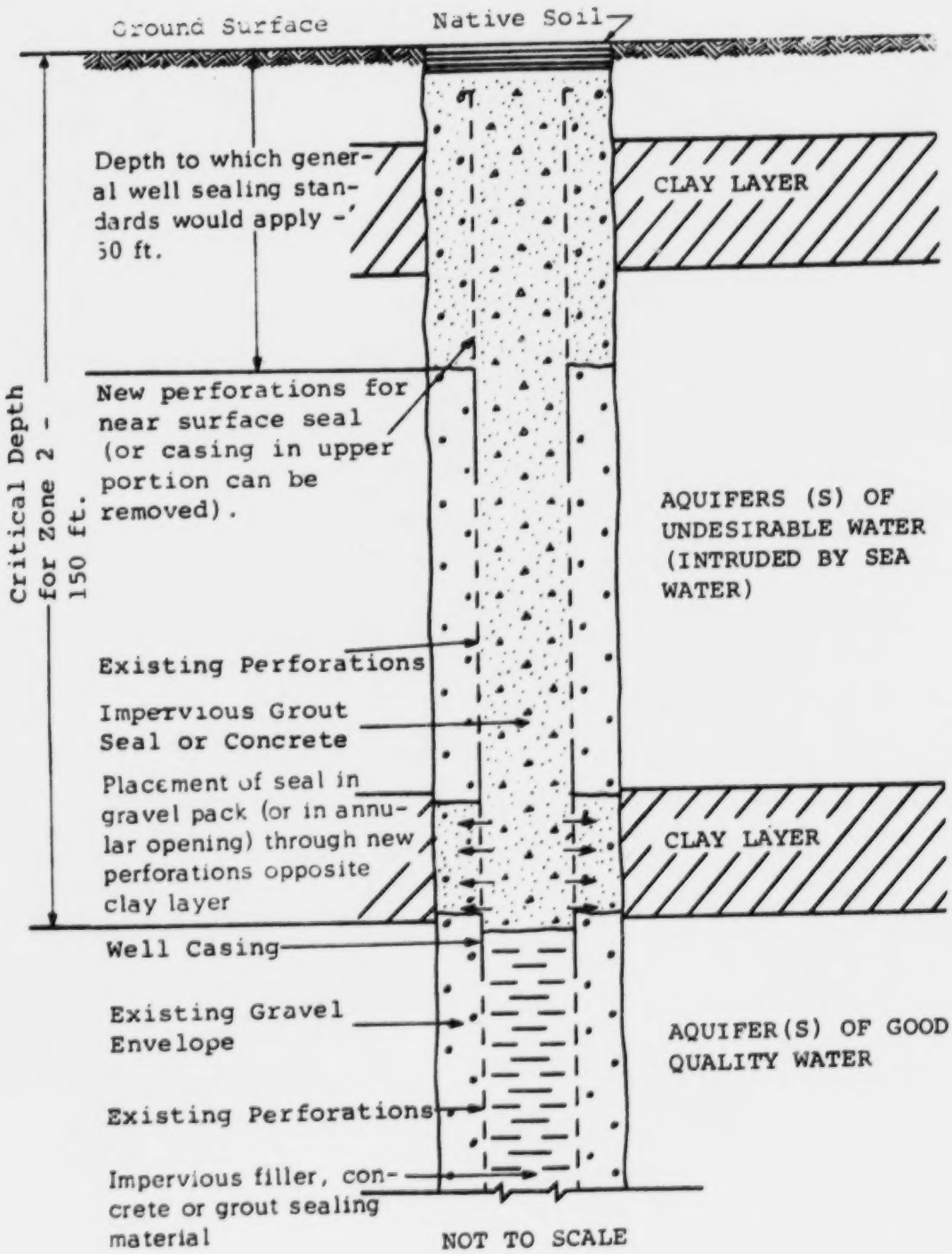

Ground Surface
Native Soil
Depth to which general well sealing standards would apply - 50 ft.
CLAY LAYER
Critical Depth for Zone 2 - 150 ft.
New perforations for near surface seal (or casing in upper portion can be removed).
AQUIFERS (S) OF UNDESIRABLE WATER (INTRUDED BY SEA WATER)
Existing Perforations
Impervious Grout Seal or Concrete
Placement of seal in gravel pack (or in annular opening) through new perforations opposite clay layer
CLAY LAYER
Well Casing
Existing Gravel Envelope
AQUIFER(S) OF GOOD QUALITY WATER
Existing Perforations
Impervious filler, concrete or grout sealing material
NOT TO SCALE

Figure 6 - Typical sealing features for destroyed gravel-packed wells in Zone 2 in Santa Clara County, California.
(Source: Santa Clara County Flood Control Water District, 1973)

The Dade County Plumbing Code has a few regulations on supply and disposal wells. Paragraph "P" states "wells shall be so located as to be free of danger of contamination from unsafe water supply or shall be at least 50 feet from a septic tank, drain field, soakage pit, or discharge well, and of sufficient depth to provide pure and wholesome water". The minimum depth of domestic water wells is specified at 20 feet.

The Dade County Sewer Code (1972) states "no unauthorized person shall cause storm water or groundwater....to enter the sanitary sewer system". Included in the code are maximum allowable values for certain materials in, or characteristics of, waste water entering the sewage systems (see Table 10).

In New York

Nassau County has no separate standards for water supply or water wells and adheres to the State Sanitary Code and water-quality regulations. The county Department of Health monitors the quality of water in supply wells. Special attention is given to the nitrate concentration in drinking water, which locally has risen beyond permissible Federal and State recommended limits.

A "Flammable Liquids Ordinance" was enacted in Nassau County in October 1972. It sets standards for fuel oil storage tanks and bulk storage plants, dike enclosures, and fire protection. One section dealing with leak detection of underground tanks requires installation of monitoring wells. The section reads as follows:

"Leak Detection. On each new underground gasoline tank installation or on the re-

Table 10. MAXIMUM ALLOWABLE VALUES FOR CERTAIN MATERIALS IN, OR CHARACTERISTICS OF, WASTE WATERS ENTERING DADE COUNTY, FLORIDA, SEWERAGE SYSTEMS

(Source: Dade County Water and Sewer Authority, 1972)

Material or characteristic	Maximum allowable value, ppm
Boron	1.0
Chromium, total	10.0
Copper	10.0
Cyanides	2.0
Cadmium	2.0
Lead	0.1
Mercury	2.0
Nickel	10.0
Zinc	10.0
Iron	25.0
Phenols	0.5
BOD	400
Suspended Solids	400
pH	5.5-9.5
Temperature	150°F

placement of an existing underground tank, galvanized wrought iron pipes of 3/4-inch inside diameter or larger, with 3/16-inch holes drilled horizontally on six-inch centers on alternate axis, shall be installed vertically to a depth of not less than six-inches below the bottom of the deepest tank. The top of this pipe shall be recessed 1/4-inch below the surface of the pavement, provided with a threaded sleeve and fitted with a removal brass plug. The surface surrounding same shall be circled with red paint. The locations on the station property shall be such that the tank or tanks are entirely surrounded with the test pipes not over twenty-five (25) feet from the closest tank, and not over twenty-five (25) feet apart. In the event of evidence of a gasoline leak in the vicinity of an existing underground gasoline storage tank, the tank owner shall install test pipes as described in the preceding paragraph for the purpose of the conducting of combustible gas indicator readings by the Fire Marshal's staff."

Sewage disposal systems in Nassau County are regulated by the Department of Health, and the county regulations are commonly more stringent than the State requirements. Permits are required for all installations except for one or two family houses. An engineering report including profiles, maps, soil borings, and percolation tests is required. The elevation of groundwater and/or perched water tables must be determined. The position of the water table and the type of soil govern the type of disposal system (septic tank, cesspool) for a particular site. A requirement for the installation of cesspools is that the bottom of the cesspool be at least 2 feet above the water table.

Examination of sewer construction regulations in Suffolk County shows no pertinent items ex-

cept for stated maximum allowable infiltration and exfiltration losses from sewer lines. Maximum losses allowed are 0.10 gallons per hour per inch of diameter per 100 linear feet of sewer. Assuming a 12-inch diameter line, the daily maximum loss allowable would be about 1,500 gallons per day for each mile of line.

SELECTED COMMISSIONS

Great Lakes-Upper Mississippi Board of State Engineers

Recommended Standards for Sewage Works (Ten-State Standards-1971)

These standards prepared by the Great Lakes-Upper Mississippi River Board of State Engineers are intended to serve as a guide in design and preparation of plans and specifications for sewage works. They are used by Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin. Several sections of these standards are summarized below:

1. Sewer joints and infiltration - Sewer joints shall be designed to minimize infiltration. Leakage outward or inward shall not exceed 500 gallons per inch of pipe diameter per mile per day for any section of the system. For a 12-inch diameter line such allowable losses would amount to 6,000 gallons per day or 2.2 million gallons per year for each mile of line.

2. Horizontal and vertical separation of water and sewer lines - Ten feet minimum distance horizontally; less than 10 feet is acceptable if lines are in separate trenches; the sewer line is to be at least 18 inches below water main invert.

3. Sludge lagoons - Use of shallow sludge drying lagoons in lieu of drying beds is permissible subject to the following conditions:

a) Soil to be reasonably porous; bottom of lagoon to be at least 18 inches above maximum groundwater table.

b) Consideration to be given to prevent pollution of ground and shallow water. Adequate isolation to be provided to avoid nuisance production.

4. Waste stabilization ponds -

a) Engineering report required including location and direction of residences and water supplies within 0.5 mile; soil borings; percolation tests, maps, etc.

b) Proximity to water supplies and other facilities subject to pollution and location in areas of porous soils and fissured rock formations to be critically evaluated to avoid creation of health hazards or other undesirable conditions. Possibility of chemical pollution to be considered.

c) Soil formation or structure of bottom to be relatively tight to avoid excesssive liquid loss due to percolation and seepage. Soil borings required. Gravel and limestone areas to be avoided.

d) Percolation not to be excessive. Sealing of bottom with clay blanket, bentonite or other sealing material to be considered.

The above requirements of sludge lagoons and stabilization ponds appear to be directed toward slow percolation and leakage of waste into the ground. Groundwater pollution is to be minimized by slow dispersion and dilution of pollutants. Addendum No. 2 of April 1971 deals with ground disposal of waste waters. Protection of groundwater and surface resources is the major concern of these guidelines. The standards call for engineering data, including geology (formations, degree of weathering of bedrock, rock structure, surficial deposits, sink

holes, etc.). Requirements under hydrology include:

a) Depth to water table, variation, type; static water levels to be determined at each depth for each aquifer in the depth under concern; critical slope evaluation to be given to any differences in such levels.

b) Direction of groundwater movement; point of discharge; chemical analyses.

c) Well data, logs, construction details, etc.

d) Minimum of one monitoring well to be drilled in each dominant direction of groundwater movement and between project site and public wells or high-capacity private wells with privisions for sampling at the surface of the water table and at five feet below the water table at each monitoring site. Location and construction of monitoring wells to be approved.

Recommended Standards for Water Works (Ten-State Standards-1972) ——

These standards are intended to serve as a guide in design and preparation of plans and specifications for public water-supply systems. They contain the following references to groundwater and protection of groundwater.

As part of the submission of plans for new groundwater supply systems, unusual geologic conditions and possible sources of contamination must be described. All sources of pollution within 250 feet of the water source and 100 feet of treated water-storage facilities must be located.

A detailed listing of well-construction requirements is given, including depth of casing, grout-

ing procedures, disinfection of gravel pack, site protection, water quality, and procedures for well abandonment.

A recent addendum to the 10-State Standard involves salt storage for highway use. After noting that improper storage of salt is causing pollution of ground and surface waters, the addendum calls for review of all salt-storage areas, protective measures to prevent groundwater pollution, and sheltered and paved storage sites.

The Railroad Commission of Texas

The rules and regulations of the Commission (1972) apply to the conservation of oil and gas and the prevention of waste thereof within the State of Texas. Eighty rules are given on various aspects of well construction, sealing, logging, valving, fire prevention, well densities, fluid injection, allowable production, refineries, pipeline tariffs, etc.

Of most importance with respect to prevention of pollution are regulations regarding sealing off of strata and protection of oil zones from infiltrating waters, and rules for general protection of surface and groundwater during drilling, plugging, producing or disposing of salt water (also applicable to exploratory wells and offshore drilling). The Commission is empowered to grant permits for salt-water disposal wells without notice or hearing provided the operator fulfills the following requirements:

a) Only inject it in non-producing oil or gas zones that contain water mineralized by processes of nature to such a degree that the water is unfit for domestic, stock, irrigation, or other general uses.

b) Prior to disposal, the applicant shall ascertain whether or not the formations are separated from fresh water formations by impervious beds which will give adequate protection to such fresh-water formations. A letter from the Texas Water Quality Board stating that the use of such formations will not endanger the fresh-water strata in that area and that the formations used for salt water disposal are not fresh water-bearing sands must be submitted.

One regulation pertains to leakage from pipelines. It states that each break or leak in any tanks or pipelines from which more than 5 barrels escape must be reported in writing to the Commission. Leakage ordinarily incident to transportation does not have to be reported.

Susquehanna River Basin Compact (1967)

This interstate Commission created by New York, Pennsylvania, and Maryland has as its purpose the planning, conservation, development, management, and control of the basin's surface andl groundwater resources. The Commission is empowered to regulate withdrawal of water to manage and control groundwater supplies but has not issued any specific regulations regarding prevention or control of groundwater pollution.

Delaware River Basin Commission

This Commission has issued regulations regarding quality of water and withdrawal of water including groundwater within the basin, but there are no specific regulations regarding groundwater pollution. Recently, however, the Commission has drafted a new policy regarding the protection of groundwater quality. These pending regulations are reviewed in Section VIII.

SECTION VI

STATUTES AND REGULATIONS OF THE FEDERAL GOVERNMENT

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 (Public Law 92-500)

This Act, which has as its objective to restore and maintain the chemical, physical, and biological integrity of the nation's waters, contains several references to groundwater which are summarized below.

Under Title 1 - Research and related programs, and subtitle "Comprehensive programs for water pollution control" (Sec. 102) (a):

"The Administrator shall prepare or develop comprehensive programs for preventing, reducing or eliminating the pollution of the navigable waters and groundwaters and improving the sanitary condition of surface and underground waters."

Under subtitle "Research, investigations, training, and information" (Sec. 104) (a) (5):

"The Administrator shall establish national programs....and equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of navigable waters and groundwaters...."

Under subtitle "Grants for pollution control programs" (Sec. 106) (e) (1):

"Beginning in fiscal year 1974 the Administrator shall not make any grant....to any State which has not provided or is not carrying out as part of its program....the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on, the quality of navigable waters and to the ex-

tent practicable groundwaters including biological monitoring; and provision for annually updating such data...."

Under subtitle "In-place toxic pollutants" (Sec. 115):

"The Administrator is directed to identify the location of in-place pollutants with emphasis on toxic pollutants in harbors and navigable waterways and is authorized....to make contracts for the removal and appropriate disposal of such materials from critical port and harbor areas".

Under Title II - Grants for construction of treatment works, and subtitle "Area-wide waste treatment management" (Sec. 208) (b)(2):

Plans for regional waste treatment shall include....

(G) a process to (1) identify....mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff and (2) set forth procedures and methods....to control to the extent feasible such sources.

(I) a process to (1) identify....salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow fram any cause, including irrigation, obstruction, groundwater extraction, and diversion and (2) set forth procedures and methods to control such intrusion....

(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

Under Title III - Standards and enforcement, and subtitle "Information and guidelines" (Sec. 304) (a) (1):

(A) "The Administrator....shall develop and publish criteria for water quality....on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation, which may be expected from the presence of pollutants in any body of water, including groundwater."

(a)(2)(A) "The Administrator....shall develop and publish....information on the factors necessary to restore and maintain the chemical, physical and biological integrity of all navigable waters, groundwaters, waters of the contiguous zone, and the oceans."

"The Administrator....shall issue to appropriate Federal agencies, the States, water pollution control agencies,....information including:

(e) (1) guidelines for identifying and evaluating the nature and extent of nonpoint sources of pollutants and (2) processes, procedures, and methods to control pollution resulting from: (A) agricultural and silvicultural activities, including runoff from fields and crop and forest lands; (B) mining activities including runoff and siltation from new, currently operating, and abandoned surface and underground mines; (C) all construction activity, including runoff from the facilities resulting from such construction; (D) the disposal of pollutants in wells or in subsurface excavations; (E) salt-water intrusion resulting from reduction of fresh-water flow from any cause, including extraction of groundwater, irrigation, obstruction, and diversion; and (F) changes in the movement, flow, or circulation of any navigable waters or groundwaters, including changes caused by the construction of dams, levees, channels, causeways or flow-diversion facilities".

Under subtitle "Water Quality Inventory" (Sec. 305) (b) (E) and (b) (2):

"Each State is required to annually submit to the Administrator (beginning January 1, 1975) a description of the nature and extent of non-point sources of pollutants, and recommendations as to the programs which should be undertaken to control each category of such sources, including an estimate of the cost of implementation. These reports, together with an analysis of them by the Administrator, are to be submitted to Congress."

Under Title IV - Permits and Licenses (Sec. 402) (b) (1) (D):

"National Pollutant Discharge Elimination System" (NPDES), The Administrator of EPA may issue a permit for the discharge of any pollutant, upon condition that such discharge will meet all applicable requirements of the FWPCA Amendments. Permit required to "(D) control the disposal of pollutants into wells."

Under Title V - General Provisions and subtitle "General definitions" (§ 502(b)):

"The term pollutant does not mean....(B) water, gas, or other material which is injected into the well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located and if the State determines that such injection or disposal will not result in the degradation of ground or surface water resources."

In compliance with the FWPCA Amendments, the EPA has issued regulations to the States for participation in the NPDES system. These are found in the Code of Federal Regulations under

Title 40, Chapter 1, Part 124. The regulations establish guidelines and describe among other things, the State statutes required, forms and data to be submitted, terms and conditions of NPDES permits, and procedures for monitoring. Subpart I titled "Disposal of Pollutants into Wells" - Section 124.80 (Control of disposal of pollutants into wells) states that any State or interstate agency participating in NPDES shall have procedures which control the disposal of pollutants into wells. Any such disposal shall be sufficiently controlled to protect the public health and welfare and to prevent pollution of ground and surface water resources.

Specific regulations are as follows:

(a) if an applicant for an NPDES permit proposes to dispose of pollutants into wells as part of a program to meet the proposed terms and conditions of an NPDES permit, the Director shall specify additional terms and conditions in the final NPDES permit which shall (1) prohibit the proposed disposal, or (2) control the proposed disposal in order to prevent pollution of ground and surface water resources and to protect the public health and welfare.

(b) A State agency participating in the NPDES shall have procedures to prohibit or control through the issuance of permits all other proposed disposals of pollutants into wells. Following approval of the Administrator of a State program pursuant to Section 402 of the FWPCA Amendments, the Director shall permit no uncontrolled disposals of pollutants into wells within the State.

(c) Any permit issued for the disposal of pollutants into wells shall be issued in accordance with the procedures and requirements specified in these regulations.

(d) The Regional Administrator shall distribute to the Director and shall utilize in his review of any permits proposed to be issued by the Director for the disposal of pollutants into wells, any policies, technical information, or requirements specified by the Administrator in regulations issued pursuant to the FWPCA Amendments or in directives issued to EPA regional offices.

The NPDES permit program to be administered by EPA also provides some protection against pollution of the groundwater. Section 125.26 (1) of Title 40, Chapter I of the Code of Federal Regulations provides:

"If an applicant for a permit is disposing or proposing to dispose of pollutants into wells as part of a program to meet the proposed terms and conditions of a permit, the Regional Administrator shall specify additional terms and conditions in the permit which shall (1) prohibit the disposal, or (2) control the disposal in order to prevent pollution of ground and surface water resources and to protect the public health and welfare."

GROUNDWATER POLLUTION AT FEDERAL FACILITIES

By Executive Order 11507 dated February 4, 1970, air and water pollution at Federal facilities is to be controlled. The specific references are as follows:

§ 4 (4) "The use, storage, and handling of all materials included but not limited to, solid fuels, ashes, petroleum products, and other chemical and biological agents shall be carried out so as to avoid or minimize the possibilities for water and air pollution."

§ 4 (5) "No waste shall be disposed of or discharged in such a manner as could result in the pollution of groundwater which would endanger the health or welfare of the public."

PROTECTION AGAINST RADIATION

Standards (Code of Federal Regulations, Title 10, Ch. 1, Pt. 20) were established for protection against radiation arising from activities under licenses by the Atomic Energy Commission (radioactive material not licensed by the AEC is not subject to these regulations). The regulations establish permissible doses and precautionary procedures such as monitoring, labeling, and storage. One section (20.304) deals with disposal of radioactive waste by burial in soil but does not refer to groundwater or possible pollution of groundwater resulting from such burials.

No licensee shall dispose of licensed material by burial in soil unless:

(a) The total quantity of licensed and other radioactive materials buried any any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix C of this part; and

(b) Burial is at a minimum depth of four feet; and

(c) Successive burials are separated by distances of at least six feet and not more than 12 burials are made in any year.

Appendix C is a list of radioactive elements giving concentrations in air and water above natural background. Concentrations range from 0.01 microcuries for Plutonium - 239 to 1,000 microcuries for Cesium-131.

PROTECTION AGAINST PESTICIDES

Federal Insecticide, Fungicide and Rodenticide Act - 1972

This statute is mainly for registration, control, and monitoring of pesticides. It contains no references to groundwater or to possible pollution of groundwater. The Administrator of the Act is to establish procedures for safe disposal of pesticides and the selections of sites for safe disposal (Sec. 19(a). Also, under § 20 a national plan to monitor pesticides in air, soil, and water is to be devised and undertaken.

EPA Regulations for Enforcement of Pesticide Act of 1972

These regulations are mostly directives for labeling, registration, and safe shipment of pesticides. One indirect reference to groundwater pollution under "labeling" (Sec. 162.116) (c)(2) says: "Products which might be injurious to fish and wildlife after extensive use or indiscriminate disposal of excess material or spray-tank washings, and which bear directions such as: To protect fish and wildlife, do not contaminate streams, lakes or ponds with this material."

Procedures for safe disposal and storage of pesticides have been proposed by the EPA Administrator as new section 165 of Title 40, Chapter I of the Code of Federal Regulations. Section 165.8(6) is directed to the feasibility of subsurface disposal of pesticides. It states:

"The effects of subsurface implacement of liquid by well injection and the fate of the injection materials are uncertain with today's knowledge, and could result in serious environmental damage requiring complex and costly solutions on a long-term basis. Well injection

should not be considered for pesticide disposal unless all reasonable alternative measures have been explored and found less satisfactory in terms of environmental protection. The agency will oppose well injection of pesticides without strict controls. It must be clearly demonstrated to the appropriate Regional Administrator that adequate preinjection tests have been made, provisions have been made for monitoring the operation and environmental effects, contingency plans have been formulated to cope with well failures, and provisions will be made for plugging injection wells when abandoned."

Section 165.2(c) states that these proposed regulations are not intended to supersede or abrogate existing State regulations which are more stringent than the federal regulations, nor are they meant to prohibit a State from establishing more stringent regulations of its own in the future.

GUIDELINES FOR WASTE WATER TREATMENT FACILITIES

These Federal guidelines, issued by the former Federal Water Quality Administration in September 1970, are intended to supplement existing guidelines such as the "Recommended Standards for Sewage Works of the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers", ASCE Manuals 36 and 37, and other applicable State standards and guidelines.

References to groundwater contamination are given under (a) "Ultimate Disposal of Sludge and Solids" and (b) "Interceptor Sewers". The following quotes are significant:

(a) "The method of final disposal (of sludge and solids) must not result in any significan degradation of surface or groundwater, air, or land resources. If there is a choice, the

method chosen must be that having the least impact on the environment."

(b) "Particular attention shall be given to ensure that sewers will be as water tight as possible. Plans and specifications shall include the following: (1) infiltration and exfiltration requirements with maximum allowable limits, (2) bedding and backfill specifications including cross section detail, (3) jointing specifications to provide for minimum infiltration, and (4) requirement for post-construction testing to determine compliance with specified limitations on infiltration".

GUIDELINES FOR SOLID-WASTE DISPOSAL

Solid-Waste Disposal Act, 1970

This act authorizes a research and development program with respect to solid waste disposal. It includes promotion of demonstration, construction, and application of solid-waste management and resource-recovery systems, technical and financial assistance to State and local governments and interstate agencies, research and development for better management and disposal techniques, and preparation of Federal guidelines for solid-waste recovery, collection, and disposal. A plan for creation of a system of national disposal sites for storage and disposal of hazardous wastes including radioactive, toxic chemical, biological, and other wastes is to be prepared. It contains no references to groundwater pollution.

Recommended Standards for Sanitary Landfill Design, Construction, and Operation-EPA 1971 [1)]

These standards require a project plan, including topographic maps showing location of borings, cross sections, and a report regarding site geology, hydrology, and soil conditions. Provi-

1) The regulations are no longer codified in the Code of Federal Regulations, but still remain in force. They can be found in 42 CFR § s 460-464 (1971).

sions are to be made to insure that no pollution of surface or groundwater is created and surface drainage is to be diverted to control infiltration at site. A daily cover of 6 inches of soil is the minimum; the final cover is 2 feet of compacted soil with provision for grading to drain surface water runoff. No requirements are listed for mapping of the water table, inventory of wells, sealing of formations, or installation of monitoring wells.

Sanitary Landfill Design and Operation - EPA 1972

This publication is a state-of-the-art treatise prepared to assist planners, designers, operators, and government officials with design and maintenance of waste disposal sites. Various hydrologic and geologic factors pertinent to landfill operations are fully discussed and illustrated. Design considerations listed include topographic maps, cross sections, and information on surface and groundwater drainage.

Proposed EPA Guidelines for Land Disposal of Solid Wastes

Recently promulgated (April 27, 1973) in the Federal Register are proposed EPA guidelines for the land disposal of solid wastes; they will be found in 40 CFR Part 241. They are mandatory for federal agencies and are recommended for use by State, interstate, regional and local government agencies. In section 241.202-2(c), it is recommended that the hydrogeology of the site be evaluated in order to design site development so as to minimize the impact on groundwater resources.

In order to more fully protect groundwater quality, section 241.204-1 requires that the loca-

tion, design, construction, and operation of the land disposal site conform to the most stringent of applicable ground and surface water requirements. (By "applicable" is meant existing Federal, State or local standards which are legally enforceable.)

The regulations recommend that the design of the site include (§241.204-2):

1) Groundwater elevation and movement and proposed separation between the lowest point of the lowest cell and the predicted maximum water-table elevation.

2) Potential interrelationship of the land disposal site, local aquifers, and surface waters.

3) Background and initial quality of water resources in the potential zone of influence of the land disposal site.

4) Proposed location of observation well, sampling stations and testing program planned, when appropriate.

5) Description of soil and other geologic material to a depth adequate to allow evaluation of the water quality protection provided by the soil and other geologic material.

6) Potential leachate generation and proposed control equipment, where necessary, for the protection of ground and surface water resources.

In operating the land disposal site, section 241.204-3 emphasizes the importance of:

1) Leachate collection and treatment systems when necessary to protect ground and surface water resources, and 2) not allowing municipal solid wastes and leachate from them to contact ground or surface water so as to impair that water's use.

SECTION VII

MISCELLANEOUS CODES AND STANDARDS

NATIONAL STANDARD PLUMBING CODE

This code published in 1971 by the National Association of Plumbing-Heating-Cooling Contractors has been prepared to provide State and local governments, administrative bodies, and industry with a sample modern plumbing code. It does not have legal standing unless it is adopted by reference, or inclusion, in the statutes or ordinances of State, county or municipal governments.

The code, founded on basic rules of environmental sanitation, has several listed principles. Principle No. 22 is as follows: "Protect ground and surface water. Sewage or other waste shall not be discharged into surface or subsurface water unless it has first been subjected to some acceptable form of treatment."

The code mentions the following standards: (1) separation of water and sewer lines a minimum of 10 feet of horizontal distance, (2) in the same trench, the water line should be at least one foot above the top of the sewer line, (3) sewer and water lines to be of sufficient strength and durability to prevent leakage, and (4) no potable water lines in, under, or above cesspools, septic tanks, septic tank drainage fields, or seepage pits; a separation of 10 feet is to be maintained.

Minimum lot sizes are given for individual sewage systems together with minimum distances and data on absorpiton areas in seepage pits and septic tanks. The effluent from all septic

tanks is to be disposed of underground by subsurface irrigation or seepage pits or both. However, "deep seepage pits penetrating groundwater" are prohibited.

A general provision of the code states that domestic sewage or sewage effluent shall not be disposed of in any manner that will cause pollution of the ground surface, groundwater, bathing area, lake, pond, water course, or tidewater, or create a nuisance. It shall not be discharged into any abandoned or unused well, or into any crevice, sink hole, or opening, either natural or artificial in a rock formation. Plumbing fixtures may not be connected to any individual sewage disposal system where groundwater may collect above the sewage disposal system causing a flooded condition.

AMERICAN WATER WORKS ASSOCIATION

The "standard of minimum requirement for safe practice in the production and delivery of water for domestic use" has only a general reference to wells and pollution, namely: "Wells shall be constructed to prevent, insofar as possible, contamination from any source. If a well casing, as set, is perforated at such levels that contaminated water may enter, adequate repairs shall be made before water from the well is used. Where impervious formations or sealing clay strata are not encountered that will prevent contaminated water from entering the well, provision shall be made for the installation of disinfection equipment." The AWWA "Standard for Deep Wells" contains no reference to groundwater pollution; however, the well contractor is required to take measures to prevent pollution of the groundwater during drilling and construction of the well. Construction methods for wells in different geological for-

mations are given together with instructions for proper cementing and sealing of water wells and zones of poor water quality.

MODEL WATER CODE

A model water code prepared by Frank E. Maloney at the University of Florida Water Resources Research Center with support from the Office of Water Resources Research (1972) has only one reference to groundwater pollution, namely the requirement that a discharge permit must be obtained prior to any discharge of water or waste into the groundwater. The author notes that no further requirements for protections of groundwater are needed since by definition "Waters of the State" includes groundwater. The code does require licensing of drillers, well permits, well-completion reports, and adoption of construction standards.

SECTION VIII

NEW DEVELOPMENTS

SELECTED STATES

Alaska

According to Mr. Ronald G. Hansen, Chief of the Water Quality Control Section of the Department of Environmental Conservation, groundwater pollution is present in the State principally where on-lot water-supply and waste-disposal systems exist in close proximity. Most cities and villages experience this problem to some extent where community sewerage systems do not yet exist, because very little land in Alaska is suitable for conventional septic tank-drain field systems. It is felt that new legislation is not necessary and that the Department of Environmental Conservation has adequate legal authority to prevent groundwater pollution. The Department has adopted emergency regulations which restrict on-lot water supply and waste-disposal systems to lots of 40,000 square feet or larger with adequate soil characteristics. These regulations were undergoing public hearing in March 1973 prior to adoption as permanent regulations.

California

Mr. L. H. Gulick, Attorney for the State Water Resources Control Board, reports (March 1973) that various environmental bills are pending but that their relationship to groundwater pollution is indirect or remote. On March 1, the Board adopted minimum guidelines to protect the water quality from animal wastes. These guidelines cover animals in confined areas and require farmers to control drainage from manure storage areas and runoff from the largest rainfall

probable during 24 hours in a 10-year period. The guidelines require minimization of water percolation through manure into underlying soils (BNA).

Delaware

New groundwater quality legislation is in preparation (May 1973). Officials of the Water Resources Division see a need for strengthening enforcement of existing statutes to better control the groundwater resources.

Hawaii

No significant cases of groundwater pollution have been reported and no new legislation in this respect is being considered; however, increase in subsurface disposal of wastes is seen as a potential problem to groundwater quality. There is diversity of opinion regarding the need for protective legislation. Mr. Sunao Kido, Chairman of the Department of Land and Natural Resources, feels that the present legislation is adequate to safeguard the groundwater supply (February 1973). Mr. Ralph K. Yukumoto, Acting Chief of the Sanitary Engineering Branch of the Department of Health, reports that more legislation aimed at the prevention of groundwater pollution is needed (February 1973).

Indiana

Mr. George G. Fassnacht, Chief, Water Supply Section, Division of Sanitary Engineering of the State Board of Health, sees no need at this time (March 1973) for State legislation regarding groundwater pollution. He feels that such pollution is covered by the Indiana Stream Pollution Control Law.

Iowa

Mr. Keith Bridson, Acting Director of the Department of Environmental Quality, feels that there is a need for improved well construction practices throughout the State (March 1973). The Department is drafting revised rules and regulations regarding the sealing of abandoned public wells.

On July 11, 1972, the State approved revised rules and regulations regarding animal waste disposal on confined feed lots. Of interest is a section which prohibits discharge of runoff water or waste flow directly into a drainage well, pumped well, abandoned well, sink hole or gravel pit, rock quarry, or lake or pond "when such lake or pond is located on property not wholly owned by the registrant." Operators of feed lots are required to submit information on topography and drainage and ultimate primary receiving streams or other waters of the State. If the department determines that the feed lot pollutes or may reasonably pollute the waters of the State, a waste-water disposal permit must be obtained and pollution-control facilities must be constructed (BNA).

Maryland

A Water Resources Administration spokesman, Mr. Arnold Schiffman, considers the State statutes complete and adequate from a groundwater protection point of view. He feels, however, that there is a need for better regulations to implement the statutes.

The State has prepared a unique approach to the classification of groundwater quality according to aquifer.

As required under the new Federal Water Pollution Control Act, the states have to submit revised water-quality standards to EPA. A preliminary draft of the Maryland Standards dated February 1973 is summarized as follows:

1. Any discharge or disposal of water or waste waters into groundwater requires approval of the Water Resources Administration. Any approval, if granted, will contain the necessary limitations and requirements to prevent pollution of ground and surface water.

2. Three aquifer types are recognized and water quality standards are established for each aquifer: Type I Aquifers (transmissivity 1,000 gpd/ft or greater) with a total dissolved solids content of less than 500 mg/liter; Type II Aquifers (transmissivity 1,000 gpd/ft or greater) with a total dissolved solids content ranging between 500 and 600 mg/liter, and; Type III Aquifers - all other aquifers.

The characteristics of waters or wastes discharged into the aquifers has tentatively been established as follows:

Type I Aquifers ——

Waste discharges into Type I Aquifers shall not exceed or cause the natural groundwater quality to exceed recommended and/or mandatory standards for drinking water of the U. S. Public Health Service.

Type II Aquifers ——

Waste discharges into Type II Aquifers should not exceed, or cause the natural groundwater quality to exceed, surface-water quality standards for the State of Maryland. Clear and

convincing proof shall be provided to show that the waste discharged will not contaminate a Type I Aquifer.

Type III Aquifers ——

Discharge of any type waste is permitted into Type III Aquifers. Conclusive proof shall be provided to show that the waste discharged will not pollute a Type I or Type II Aquifer or surface water.

A logarithmic graph has been prepared to show aquifer types for groundwater quality standards (see Figure 7). Point "A" on the graph is based on the 1962 U. S. Public Health Service Drinking Water Standards recommended limit of 500 mg/l for total dissolved solids and the approximate permeability boundary between silt and sand. Transmissivity is used as the measure of aquifer productivity because it takes aquifer thickness into account and is also a parameter that can be readily determined.

Point "B" on the graph is based on the concept that brackish groundwaters could be eonomically desalinized by processes whose costs are a function of feed water salinities. The total dissolved solids content of 6,000 mg/l is based on approximate upper limits for reverse osmosis desalinization and a rough estimate of average dissolved-solids content of the Chesapeake Bay. A transmissivity value of 10,000 ft^2/day is considered to be a lower limit for well yields large enough to warrant desalinization. The dashed line connecting points A and B is arbitrary.

Regulation 4.07 of the Water Quality Standards covering prevention of oil pollution prohibits

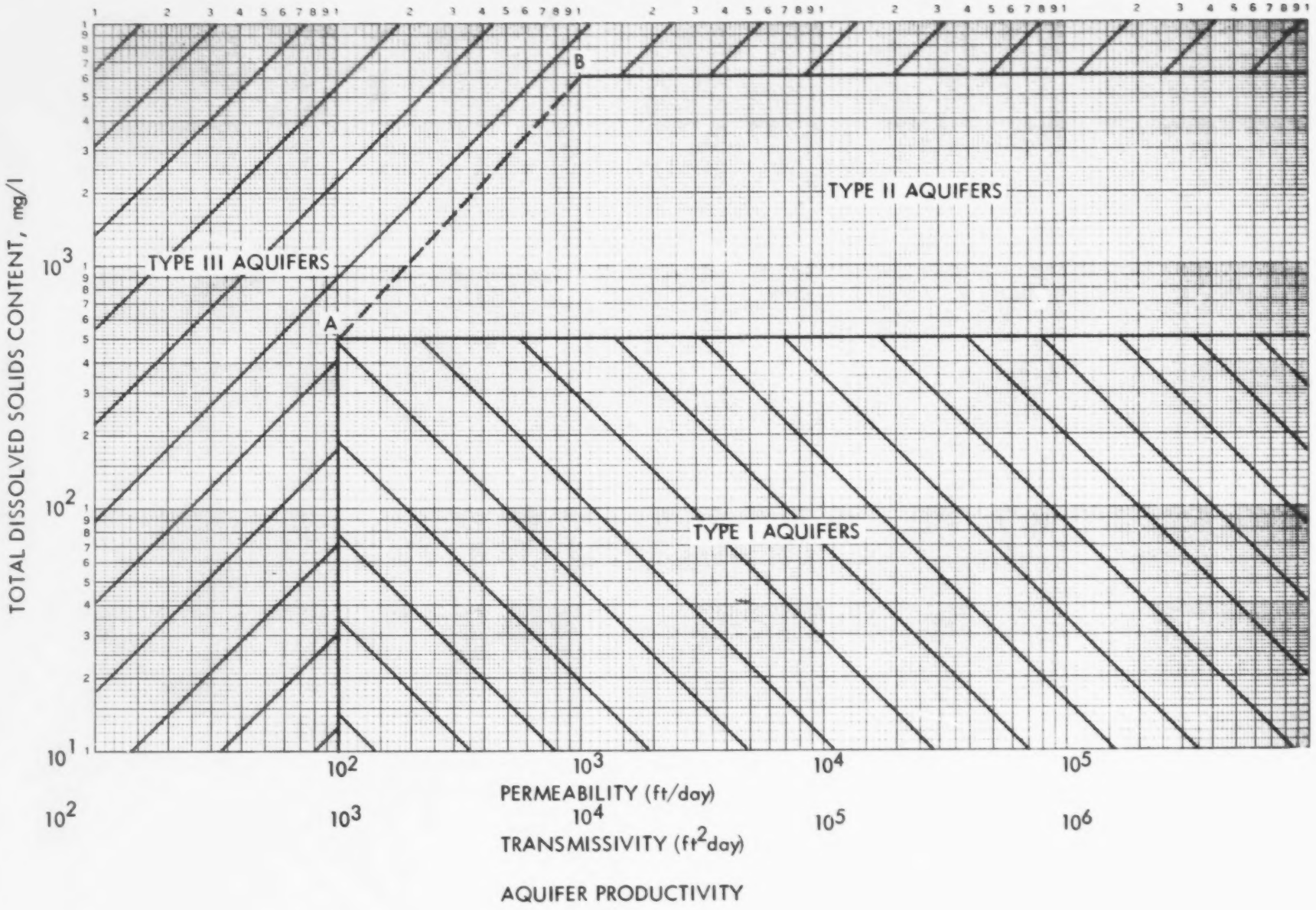


Figure 7 - Logarithmic chart showing aquifer types for ground-water quality standards in Maryland.
(Source: Maryland Water Resources Adm. 1973)

discharge of oil into the waters of the State. There are no specific references to groundwater pollution, except that in designing new above-ground oil-storage sites and buried tanks, the nature of the soil and the groundwater conditions must be taken into consideration.

Massachusetts

Actual incidents of groundwater pollution caused by use and storage of road salts have caused concern for groundwater quality in the State, and legislation regulating storage and use of such chemicals is pending. Pertinent sections of the proposed legislation are as follows:

"no person shall store rock salt, sodium chloride, or chemically treated abrasives or other chemicals used for de-icing roads in such a manner or place as to subject a water supply or groundwater supply to the risk of contamination."

"any person who uses more than one ton of such chemicals in any calendar year shall report annually."

The commissioner may require impact studies of maintenance of highways and influence on reservoirs, pond, streams, lakes, wetlands, and groundwater aquifers.

Other pending legislation in the State is:

House Bill 1946 which calls for directing the Water Resources Commission to conduct an investigation and study of the physical relationship between ground and surface water; and the inter-related effects of man's activities on ground and surface waters. The report is to contain conclusions, recommendations, and drafts of legislation as required.

House Bill 5931 calls for the assessment of and the reimbursement for damages due to contamination of private water supplies caused by storage of highway salt.

Minnesota

The Minnesota Pollution Control Agency has recently held hearings on a proposed regulation to prohibit or control groundwater pollution. In conjunction with the proposed regulation, the agency has requested additional legislative authority (proposed regulations not available, April 1973).

Mississippi

Legislation to create groundwater management districts will be introduced in the Mississippi Legislature in 1973. "Strict statewide regulations are not required at the present time, but a legal vehicle capable of dealing with emergency groundwater problems is long past due", a report states. The legislature will also be called upon to consider recommendations which enable the State Water Board to increase its data-collection activities relating to groundwater conditions (The Ground Water Newsletter, December 26, 1972).

Missouri

The Missouri Clean Water Commission has pending regulations to prevent groundwater pollution from wells. These regulations prohibit release of wastes to groundwater or storage or disposal that might cause wastes to enter the groundwater, directly or indirectly. No waste water is to be introduced into sink holes, caves, fissures, or other openings in the ground which "do or are reasonably certain to drain into aquifers". Abandoned wells are to be plugged and sealed.

New Hampshire

According to Mr. William C. Ayer, Assistant Director, Municipal Services of the Water Sup-

ply and Pollution Control Division, "the existing body of law does not approach the problem" (of groundwater pollution). There is no legislation proposed in this regard (April 1973).

Tennessee

House Bill 80 is an Act to control drilling and abandoning of waste wells and test wells installed for exploration of minerals. It is designed to prevent surface and underground waste. Underground waste means "drainage or injury to potable water, mineralized water, or other subsurface resources". The Director of the Division of Geology shall administer the Act and exercise the following powers:

a) To adopt.....rules and regulations necessary for the implementation of this Act and the prevention of pollution, underground waste, and surface waste.

b) To adopt, without notice or hearing, rules and regulations relating to procedural matters, the filing of reports, the filing of permit applications, and other procedural matters.

c) Make inspections and provide for the keeping of records and checking on the accuracy thereof.

d) Require the locating, drilling, deepening, reworking, reopening, casing, sealing, injecting, mechanical and chemical treating and plugging of wells subject to this Act to be accomplished in a manner which is designed to prevent surface and underground waste.

e) Require on all wells the keeping and filing of logs containing data which are appropriate to the purposes of this Act. Logs, samples and data for test wells drilled for exploratory purposes shall be held confidential for two years and upon written request for an additional two years.

f) Require on storage and waste disposal wells, when specified by the Director, the keeping and filing of drillers' logs and sample logs, the running and filing of electrical and radioactivity logs, the keeping and filing of drill cuttings, cores, water samples, pilot injection test records, operating records and other reports, when requested by the Director.

g) Release to the board for meetings and hearings, only data described in this section which are necessary to the administration of this Act in the prevention or correction of surface or underground waste.

h) Order through written notice the immediate suspension or prompt correction of any operation, condition or practice fround to exist which is causing or resulting, or threatening to cause or result, in surface or underground waste or pollution.

Permits are required for the drilling of test wells and the installation of storage or disposal wells. The paragraph pertaining to storage and disposal wells is as follows:

"A person shall not drill, or begin the drilling, of any storage or waste disposal well, or convert any well for these uses, until the owner, directly or through his authorized representative, files a written application for a permit to drill or convert a well, files a survey of the well site, files an approved surety or security bond, and receives a permit in accordance with the rules of the Director. A person must have a permit to dispose of waste from the water quality control board prior to application for such disposal under the Mineral Well Act. A fee of $50.00 shall be charged for a storage or waste disposal well permit. Within 10 days after receiving the prescribed application and fee, and following investigation, inspection and approval, the Director shall issue the well permit. No permit shall be issued to any

owner or his authorized representative who does not comply with the rules of the Director or who is in violation of this Act or any rule of the Director. Upon completion of the drilling or converting of a well for storage or waste disposal and after necessary testing by the owner to determine that the well can be used for these purposes and in a manner that will not cause surface or underground waste, the Director, upon receipt of appropriate evidence, shall approve and regulate the use of the well for storage or waste disposal. The Director may schedule a public hearing to consider the need or advisability of permitting the drilling or operating of a storage or waste disposal well, or converting a well for these uses, if the public safety or other interests are involved."

Texas

The pending Land-Use Management Act, devised to establish a system of land-use regulations and planning in order to protect environmentally sensitive areas, open spaces, etc., includes "geologically discernible recharge zones of underground aquifers" as one type of such sensitive areas.

Pending House Bill 935 dealing with the creation, powers, and duties of underground water conservation districts has among its provisions the conservation, preservation, protection, recharging, prevention of waste, and protection of the quality of groundwater, to control subsidence, to buy, sell, and to transport water. The Texas Water Development Board would create these districts and designate critical areas. The districts could make and enforce rules providing for conservation, protection, well drilling, well spacing, and production. Permits for production of over 100,000 gallons per day would be required, except for domestic, livestock, and agricultural wells.

Utah

Mr. S. Bryce Montgomery, geologist with the Division of Water Resources, reports that the present statutes are considered sufficient to insure protection of groundwater resources. However, he feels there is a need for improved regulation and enforcement to actually implement "all that could and should be done" (April 1973).

Vermont

Pending Bill S. 123 states: "It is the policy of the State that groundwater resources shall be protected, regulated, and where necessary, controlled in order to protect and promote the general welfare of the public".

"The secretary shall control the pollution of the groundwater resources and shall develop a comprehensive long range program to protect these resources - by January 15, 1974" (April 1973).

Virginia

The pending Groundwater Act of 1973 is a complex document to control and manage the groundwater resources of the State. It contains provisions or registration, wells, critical groundwater areas, withdrawal permits, etc. The State Water Control Board will be authorized to prescribe standards for abandonment of water wells, and if the groundwater in an area has been or reasonably may be expected to become polluted, the Board may declare the area to be a "critical groundwater area" subject to management and regulations.

Wisconsin

Monitoring of groundwater sources used as the sole water supply for 446 communities in Wisconsin is being proposed in bills in the State Legislature. Other proposals call for increased research on existing and potential hazards to the aquifers.

One bill would appropriate $120,000 in the next two fiscal years to determine the characteristics of the water and changes in quality due to human activity. The research, which would be conducted by the University of Wisconsin, would attempt to isolate the types of contaminants that pose a threat to the water. Groundwater experts in the State are concerned that changes in waste disposal and land use procedures may be destructive to water (The Ground Water Newsletter, March 27, 1973).

REGULATORY COMMISSIONS

Ohio River Valley Water Sanitation Commission (ORSANCO)

ORSANCO is preparing regulations for underground injection of waste waters. A working copy of a report prepared by Mr. Don L. Warner, dated June 1972, was reviewed.

The report includes various forms and outlines for regulation of underground waste water injection, such as application for drilling, completion, and operation of a well, and application for plugging and abandoning a well.

Geologic and hydrogeologic criteria for deep-well disposal are: (1) the regional geologic framework, (2) local geology and hydrogeology, (3) groundwater aquifers (depths, thickness,

general character, use), and (4) mineral resources. The salinity of groundwater as a criterion is discussed, as are mineral resources (oil, gas, coal, salt), seismicity, hydrodynamics, well design, operating program, and abandonment of wells.

Mr. Russell A. Brant, geologist with ORSANCO, reports (February 1973) that ORSANCO recognizes the ever-increasing encroachment of pollution in potable groundwater from point sources as well as areal sources (recharge from polluted streams), and infiltration from various pollutants directly to the shallow aquifers. The very large number of point sources of pollution is of concern; however, ORSANCO is presently occupied with surface-water problems to such an extent that preparation of appropriate legislation on groundwater is not possible at the present time.

Delaware River Basin Commission

The Commission has prepared a new policy relating to the protection of groundwater quality which will be published in Title 18, Chapter IV of the Code of Federal Regulations. The main points are:

1. The quality of groundwater in the basin must be maintained in a safe and satisfactory condition for use as domestic, agricultural, industrial, and public water supplies.

2. Degradation of groundwater quality is to be prevented.

3. The groundwater shall not contain pollutants in concentrations sufficient to endanger or preclude water uses to be protected. Concentrations shall not exceed U. S. Public Health Service drinking water standards.

4. The Commission is authorized to regulate the processing, handling, transportation, disposal, storage, excavation, or removal of any solid, liquid, or gaseous material on or beneath the ground surface in order to protect the groundwater.

5. No toxic or color, taste, or odor-producing substances are allowed to enter groundwater.

6. Heat discharge which may adversely affect groundwater is to be regulated.

7. The Commission may require abatement programs of polluted groundwater.

FEDERAL GOVERNMENT

Pending Legislation

The proposed "Safe Drinking Water Act of 1973" provides for establishment of minimum Federal drinking water standards, maximum allowable limits for contaminants in water, and standards for operation and maintenance of drinking water systems. To assure safe drinking water, surveillance, monitoring, site selection, and construction standards for public-water supply systems would also be established. It was passed by the Senate on June 22, 1973, and was sent to the House; it passed a House Commerce Subcommittee on July 18, 1973.

National Water Commission

In a recent draft report prepared for the President and Congress, the chapter on "Improving Groundwater Management" sets forth specific recommendations developed by the Commission, which it feels will "effect the desired improvement in management of the Nation s groundwater resources". The final report was sent to the President and to Congress on June 14, 1973.

In summary they are:

1. Integrating Use of Surface Water and Groundwater

   a) Where surface and groundwater are interrelated, uses should be managed conjunctively and State laws should integrate rights in both sources.

   b) Laws and regulations should require users to substitute one source of supply for the other when such substitution will optimize use of the combined resource.

2. The Need for Management

   a) Public management agencies should be established to conjunctively manage groundwater and surface water in States where groundwater is an important source of supply.

   b) State legislation establishing water management agencies should confer upon such agencies sufficient authority to insure that groundwater and surface water are managed together optimally.

   c) State laws and regulations should protect groundwater aquifers from damage.

   d) Federal agencies seeking authorization of Federal water projects should report to Congress on the status of groundwater management programs in the areas where such projects are proposed.

3. Groundwater Pollution

   a) The U. S. Geological Survey should expand its studies of groundwater pollution.

   b) States should regulate wells and license drillers to protect groundwater quality.

c) The same State agency that regulates surface-water quality should regulate groundwater quality.

d) A State agency should regulate land use to control or eliminate adverse effects on groundwater quality.

e) Federal agency reports on water-supply projects should describe groundwater quality and the adequacy of programs to control groundwater pollution where Federal projects are proposed.

f) Federal water pollution control legislation should be expanded to include groundwater pollution, and regulatory techniques (although not necessarily standards) should be the same for both surface and groundwater.

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